

Technology Review

EDITED AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

FEBRUARY/MARCH 1992

\$3.00

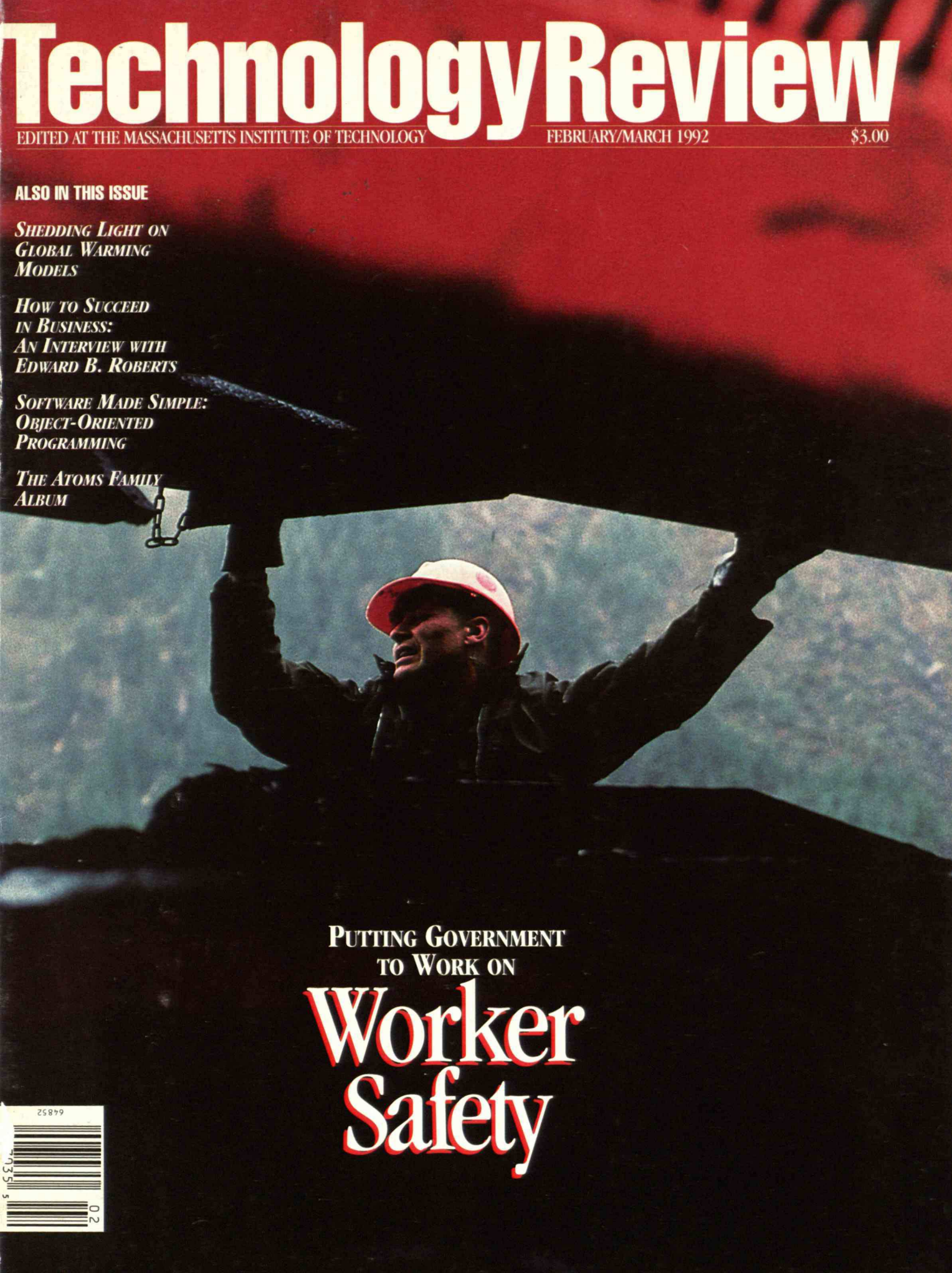
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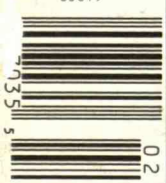
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PUTTING GOVERNMENT
TO WORK ON
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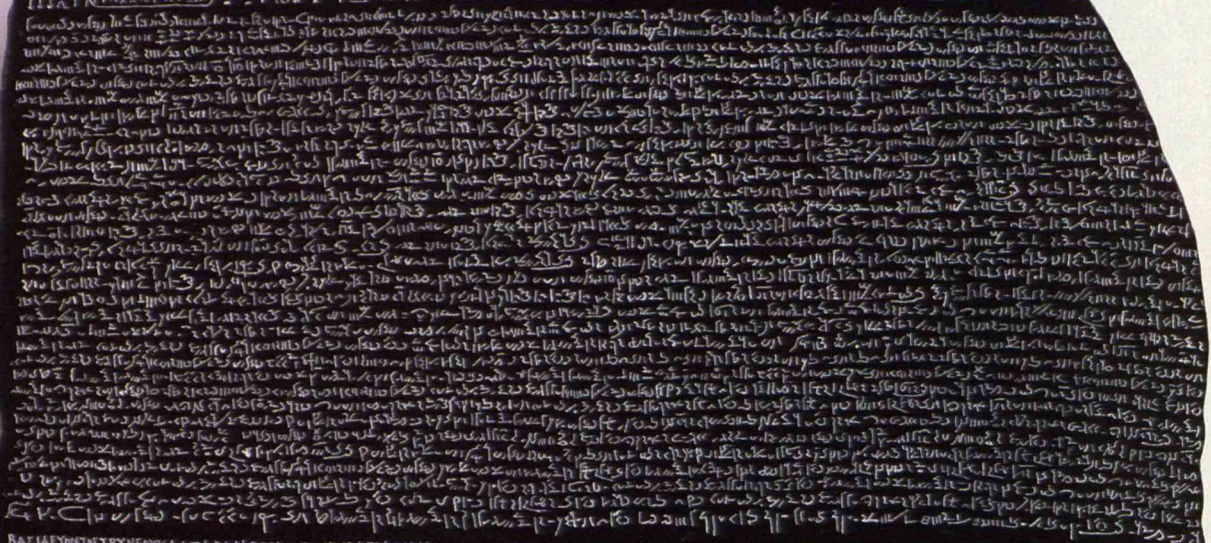
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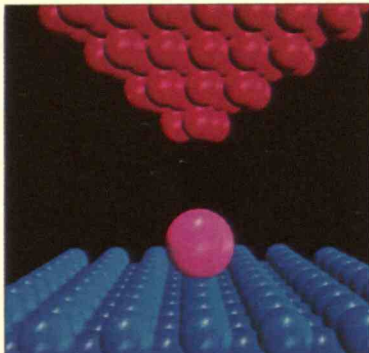
INVESTING IN THE GENIUS OF THE MIND

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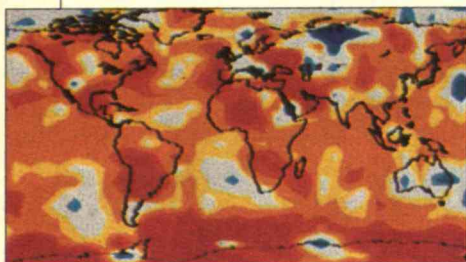
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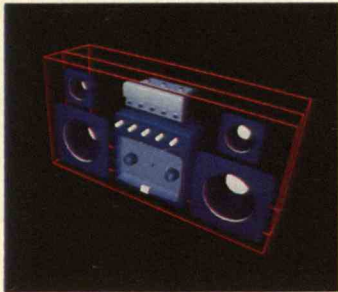


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Design: Kathleen Sayre

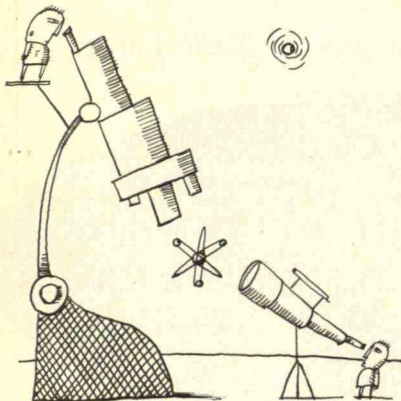
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Technology Review (ISSN 0040-1692), Reg. U.S. Patent Office, is published eight times each year (January, February/March, April, May/June, July, August/September, October, and November/December) by the Association of Alumni and Alumnae of the Massachusetts Institute of Technology. Entire contents © 1992. The editors seek diverse views, and authors' opinions do not represent official MIT policy. We welcome letters to the editor. Please address them to Letters Editor.

Editorial, circulation, and advertising offices: *Technology Review*, Building W59, MIT, Cambridge, MA 02139, (617) 253-8250; FAX (617) 258-7264. Printed by Lane Press, Burlington, VT. Second-class postage paid at Boston, MA and additional mailing offices. Postmaster: send address changes to *Technology Review*, MIT, Building W59, Cambridge, MA 02139.

Subscriptions: \$24 per year, libraries and organizations \$27. Canada add \$6, other foreign countries add \$12. Contact *Technology Review*, P.O. Box 489, Mount Morris, IL 61054, (800) 877-5230 or (815) 734-6309; FAX (815) 734-4205.

Advertising representatives: Mark E. Lynch, Eastern Sales Manager, 9 Salem Drive, Saratoga Springs, NY, (518) 583-6086; The Leadership Network: SalesConcepts, Inc., 72 Spring Street, New York, NY 10012, (212) 941-8172; Detroit: Keith Olsen/Media, Birmingham, MI, (313) 642-2885.



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First Line

Looking for a Few Hungry Samurai

IN *The Seven Samurai*, a film of Akira Kurosawa, a group of beleaguered farmers in medieval Japan entreat their village elder for advice on protecting themselves from bandits.

"Hire samurai," he suggests blandly.

But how could we pay these elite warriors, the astonished farmers ask, when all we have is grain?

"Find *hungry* samurai," says the elder.

The editors of *Technology Review* are not being preyed upon by bandits, thankfully, but, like Kurosawa's farmers, we are on the lookout for "samurai"—scientists, technologists, and related professionals—who are "hungry" enough to take a little time out from their usual activities to share some of their knowledge and opinions, in their own words and at length, with the public. Our experience is that such "expert authors"—whom we can offer more than grain, though not much more—provide readers with fresh, interesting, and useful ideas.

Of course, experts can be real headaches for editors. They can lack journalists' flexibility and investigative skills. They sometimes have difficulty seeing the big picture, and are prone to lapsing into self-serving spiels. Whereas journalists respect word counts and deadlines, experts regard them the way Boston drivers interpret red lights—as advisory only.

Nevertheless, expert authors can draw on years of experience to present a problem or opportunity, offer detailed analysis of options, and supply thoughtful, pragmatic recommendations. And, with a little editorial help, these authors can present it all in a readable, even enjoyable form that allows a wide-ranging audience access to concerns ordinarily confined to discourse with colleagues. Readers may then, we hope, apply these insights to society's benefit.

If any "hungry samurai" out there

wish to try their hand at such difficult but rewarding efforts, here are a few suggestions to help make the process easier and improve the probability of success:

First make a proposal. Submit a brief outline or synopsis before doing any serious writing. Its purpose is not to provide great detail but to sketch the author's intended structure. It should reveal the logic of the article—what you ultimately want to tell the reader, and the steps needed to achieve that goal—thereby allowing editors the opportunity to respond with specific suggestions.

*Expert authors:
can't live with 'em,
can't live without 'em.*

Tell a "story." Don't simply present a load of data or a string of facts. Your article should of course be replete with specific information, but in context. There should be some reason—an event, a new development, an intensifying rivalry between major players—why the nonspecialist reader will be tempted to sit down with the article.

Choose a subset. Having a great deal of knowledge can actually be a problem in writing a general-interest article. Whereas a journalist's product represents essentially what that reporter has learned about a subject, an expert's article can reveal only a small fraction of his or her grasp of the field. But that's all the reader needs. Pick just the material for telling the story at hand, and reserve the rest for other projects.

Cite other experts. Don't limit readers to what you yourself know. Despite that "great deal of knowledge," an expert will usually not have all the information required for a particular article. Fill in the gaps by citing other sources. This adds richness and credibility—even spice, if interesting quotes are used.

Acknowledge interfaces. A piece on "technology and its implications"—this

magazine's beat—must transcend disciplines. Thus your article will abut areas outside your field that nevertheless affect the issues at hand. Don't shy away from discussing such topics—addressing them is usually what makes the article a story—but don't overreact by waxing omniscient. Simply convey the situation as you see it.

Don't preach to the converted. Readers want to know your opinions, even those with strong political implications. But it's important to assume that readers are intelligent skeptics who don't already agree with you—otherwise, why bother to write?—yet who are willing to be convinced. The key is to present enough material, including a fair rendering of opposing viewpoints, so that readers can decide for themselves. "The best way I know of persuading you of anything," says MIT physicist Philip Morrison, "is not to plead with you to trust me, not to invoke authority in general, not even to call upon some expert, but to show you just what it is that persuaded me."

A CHANGE ON THE MASTHEAD

We welcome a new senior editor, Philip J. LoPiccolo, to *Technology Review*. An industrial engineer by training, Phil has been a science and technology editor for the past 14 years. His efforts have enhanced the pages of *Modern Materials Handling*, *Popular Computing*, *Massachusetts Medicine*, and, most recently, *Computer Graphics World*, where he was editor-in-chief. He succeeds Marc S. Miller, who has become publications director of Cultural Survival, a public-interest organization based in Cambridge. Marc's six-year tenure here was notable for his great productivity and editorial strength. His abiding social concerns and his ability to convert a manuscript into a first-class article are manifested in his last project—this issue's cover story, "Keeping OSHA's Feet to the Fire."

—STEVEN J. MARCUS

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Letters

NUCLEAR OPTIONS

"A Practical Route to Fusion Power" by Ralph Moir and Abraham Szöke (*TR July 1991*) seems to have been written without serious thought to economic or environmental issues.

The authors claim that a 1-kiloton explosion would be needed every 20 minutes to yield 1,000 megawatts of electrical power. If a plant operated 7,000 hours per year, it would require 21,000 nuclear explosives, and about 100 such plants would be necessary to make a substantial contribution to the electricity supply. That would mean manufacturing 2.1 million nuclear explosives every year. As the history of nuclear weapons production in the United States has shown, the environmental costs could be considerable.

The authors' estimates of the costs of the generating stations are also out of line. The proposed facility would be at least as complex in its construction and safety features as a breeder reactor and associated reprocessing plants, especially since it would *not* be a 90 percent fusion system but principally a fission-based one. (Fusion power is advertised in big print and splashy graphics on the cover of the magazine, but the fine print shows that no date is specified for the realization of this vision.) When one takes into account the need for extensive containment to prevent accidental pollution of the soil, the system is likely to be far more expensive than the 4 cents a kilowatt hour Moir and Szöke estimate.

Finally, if containment at one of the power plants ever failed, the site could turn into a permanent, unlicensed, uncontained waste dump for highly radioactive materials. Given that finding a single site for a highly engineered repository has been impossible so far, it is sheer wishful thinking to imagine that dozens of communities would be willing to host such power plant complexes.

ARJUN MAKHIJANI

Institute for Energy
and Environmental Research
Takoma Park, Md.

For nuclear engineers who have worked to develop safe nuclear power plants, Langdon Winner's "Fear and Loathing on the Nuclear Bandwagon" (*TR August/September 1991*) is a disappointment. I'll give him his point on the bad taste of ads expressing concern about oil supplies that come from the Middle East. But nuclear power's performance figures, to which he refers dismissively, are cold, hard facts, published in Department of Energy (DOE) statistics, countless industry newsletters, and the proceedings of technical conferences.

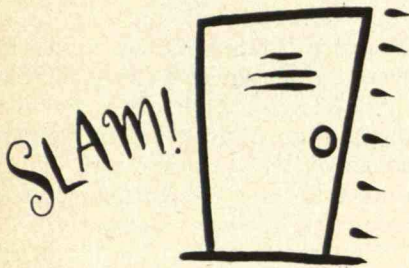
Winner also cites a poll in which 75 percent of the respondents listed renewable energy as their first or second choice for funding, and he concludes from this that the American people might be ahead of policymakers in their willingness to accept changes in the way the country uses energy. But would the results of that poll have been different if the pollsters' question had included a realistic estimate of how much electricity renewables can actually provide? I think it would have. And, of course, there are other polls. One conducted by Cambridge Energy Research Associates for the U.S. Council on Energy Awareness shows that 80 percent of the American people think nuclear plants will be important in meeting our future demands for electricity.

Moreover, Winner has got the point all wrong on public participation in a reformed licensing process. The fact is that the process has lost the confidence of the industry it regulates because it has become unpredictable and easy to abuse by groups opposed to a single plant or to nuclear power in general.

And as for "inherently safe reactors," I banned that term from DOE use back in 1986. Yet nuclear critics still bring it up, accusing "the industry" of promising something we all know is not credible.

A. DAVID ROSSIN
Los Altos Hills, Calif.

The writer was an assistant secretary for nuclear energy at DOE from 1986 to 1987.



FOSTERING INNOVATION

In "The Invention That Got Away" (*TR August/September 1991*), Richard Florida and David Browdy make some factual errors in discussing my "active matrix" technology for flat-panel computer displays.

For example, contrary to what the top table on page 46 indicates, RCA focused on standard liquid-crystal displays in the 1970s and did no work on active-matrix displays until the mid-1980s. Furthermore, it's misleading to say that "Westinghouse was not alone" in its work on active-matrix technology during the early days of flat-panel development. In fact, Westinghouse was the only company in the world working on active-matrix displays from 1972 to 1979.

As for the difficulties at Panelvision, the firm was in Pittsburgh, not Silicon Valley, so when we had to change our manufacturing process, we could not attract good photolith people. This significantly delayed production, and no amount of top-management wizardry could affect that. However, the statement that the company failed to "come up with a commercial product" is, in plain words, wrong. Panelvision put a sophisticated display controller and three different versions of a first display into production. A high-resolution display was in advanced development as well. By the time the company was sold, it had 80 highly satisfied customers and a sheaf of repeat orders but no equipment with which to increase production.

I disagree with Florida and Browdy that "it should not be too difficult" for

U.S. computer companies to form joint ventures with Japanese makers of active-matrix displays. After all, Japanese manufacturers have not invested billions of dollars in active-matrix technology so they can supply their competitors. On the contrary, they are on record as saying that they intend to sell active-matrix displays only as part of their finished product. This is precisely the situation about which I have repeatedly warned U.S. computer companies—clearly in vain.

T. PETER BRODY
Active Matrix Associates
Pittsburgh, Pa.

Prof. Florida's pro-Japanese/anti-American bias shows through in his article on the active-matrix display, just as it did in the article he wrote with Martin Kenney ("How Japanese Industry Is Rebuilding the Rust Belt," *TR February/March 1991*).

Unfortunately, Prof. Florida's research for this current article is flawed as well. I was personally involved as an investor in Panelvision, the principal vehicle of Mr. Brody's efforts to develop flat-screen technology. I also worked with Tim de Silva, the CEO the authors mention. And I was singularly unimpressed with the industry, diligence, resilience, and work habits of Mr. Brody and his coterie.

If Prof. Florida and his co-author had taken the time to interview Mr. Brody's financial backers and Tim de Silva, they may well have reached the conclusion that particular individuals failed, not U.S. business as a whole.

PHILLIP HARTLEY SMITH
President of Smith, Yuill and Co.
Pittsburgh, Pa.

The authors respond:

Dr. Brody is quite mistaken to suggest that Japanese companies will provide active matrix displays only as components of finished products. Major Japanese flat-screen makers already supply a large share of the screens used by U.S. computer makers. And as for

Mr. Smith's allegations, we went to great pains to interview the relevant principals, including Dr. Brody's financial backers at Westinghouse and in the venture capital community, as well as his management and technical colleagues at Westinghouse and in the two startup companies.

PROBLEMS WITH PEER REVIEW

In "Peer Review: Treacherous Servant, Disastrous Master" (*TR October 1991*), Charles W. McCutchen reports that a paper I wrote with my student Dr. Timothy P. Harrigan was rejected by the *Journal of Biomechanics* and published in the *Archives of Rational Mechanics*. This is not exactly true, even though I may have given Dr. McCutchen that impression. Dr. Harrigan and I knew firsthand from editorial officers at the *Journal of Biomechanics* that they would not publish our manuscript, so we submitted it to the *International Journal of Solids and Structures*, where it was accepted.

That minor error aside, Dr. McCutchen's article is refreshing in its trenchant description of the peer review system. Given the "circle-the-wagons" tendency endemic in the scientific community, it's good to see a spade called a spade.

It's worth mentioning as well that although Dr. McCutchen does not say so in his article, he has done more than just write about the issues that trouble him. Specifically, he tried unsuccessfully to get Dr. Van Chao Shein Mow, who dominates the field of skeletal lubrication, to acknowledge that the broadly disseminated "Mow biphasic" theory is not original.

The National Institutes of Health (NIH) assembled a panel to explore the matter and ended up exonerating Dr. Mow, but that is hardly surprising: of the three panel members, one was not knowledgeable in the field and another was collaborating with Mow on a book at the time. When I pointed out the conflict of interest to NIH acting director

William F. Raub, my comments were dismissed. Yet in at least one other celebrated case, the NIH Office of Scientific Inquiry re-formed a review panel after it came to light that one or more of the members had collaborated with the subject of an investigation. Why was Dr. Mow treated differently?

ROBERT W. MANN

Whitaker Professor of
Biomedical Engineering
MIT

Science today is indeed a jungle; however, I cannot agree that it is the peer review system that has made it that way. As a biomedical scientist, I have been part of peer review at NIH both as a reviewer and a reviewee. I am not one of the "establishment scientists who have been treated well by peer review," but I believe that although the system is imperfect, it is not out of control.

By perceiving peer review as the "power of scientists over one another," McCutchen has politicized the process to begin with. It is also incorrect to characterize the executive secretaries of study sections, who appoint study-section members, as a bunch of passive bureaucrats. Some executive secretaries are extremely careful in recruiting study-section members and attend scientific meetings to interview candidates. The new recruits serve on an ad hoc basis until their competence and attitude have been assessed. Not only that, but executive secretaries can invite any scientist to a particular committee meeting as an ad hoc member for reviewing a particular application.

Peer review is imperfect because it is a job done by human beings to formulate opinions, not one done by computers to generate data. The charge that has most frequently been made against reviewers is "bias," but as human beings, none of us is free from bias. Furthermore, I strongly disagree with the suggestion that in grant giving, program managers are better decision makers than peers—the fact that they are not grant seekers themselves does not make them bias-free. And I am horrified to

hear for the first time, in McCutchen's article, that "Department of Defense managers can fund whomever they like, without having to get advice." I cannot imagine that once someone is made a manager in the federal government, he or she becomes superhuman in judgment. If cronyism could be practiced in a study section of 15 or more members, wouldn't it be even more likely with a single individual behind a closed door?

McCutchen argues that unlike peers, program managers are visible and can be called to account for their decisions. But called to account by whom? Suppose a program manager decides to deny funds to a scientist who turns out to win a Nobel Prize years later. Should he or she be sued by the Nobel laureate? Or suppose the manager funds people who are later found to engage in research fraud. Should he or she be fired?

And then there's the case of the National Science Foundation (NSF), where, as Dr. McCutchen enthusiastically notes, managers "correct for peer bias" and make the final funding decisions. I would like to point out that some program directors at NSF are active scientists recruited from universities on a two-year rotational basis and are, in effect, peers. In those instances, it is peers who "correct for peer bias," and the procedure is not different from that at NIH.

What has made grant review frustrating to the reviewees is not unchecked politics but the declining rate of funding—in the last three decades, the U.S. work force in scientific research has grown to a size far beyond what the taxpayers are ready to support. If all approved applications were funded, as they were in the early 1960s, the process of filtering out the few proposals of more dubious merit would not be controversial. Even if only half of the applications were funded, there still wouldn't be much of a problem. But when fewer than 20 percent of the applications are funded, as is the case in my area of neuroscience, the situation becomes serious. While those proposals that are funded are indeed worthy of support, a

substantial number of equally valuable proposals are filtered out.

It is true that the project grant system favors research aimed at data-gathering within established paradigms and discourages "great ideas that are not yet thought of." However, the reason for this is not that reviewers fear unexpected discoveries by their competitors, as McCutchen believes. Rather, it is difficult enough to determine the top 15 or 20 percent of applicants even when the proposals have clear goals and realistic approaches—let alone when they are based on speculation, however creative the ideas may sound. Also, in comparing one great idea with another, how can the reviewer determine which is greater without bias, an attitude McCutchen has so criticized? Some people have suggested that NIH and NSF set aside a budget to encourage bold and innovative research. But since peers are unfit to evaluate great ideas, who should determine which of these proposals is funded? The director of the Bold and Innovative Research Program at NIH or NSF?

An alternative to the project grant system is the block grant system, in which funds are provided to universities rather than to individual projects. According to McCutchen's proposition, "the schools would decide who to support however they wished, using any system they wished, from despotism to democracy." But what would this mean in practice? Could the dean or vice-president for research make despotic decisions, remote from university politics? Or, to take the democratic approach, should the peer review system be brought back? And if that happened, would individual scientists be better off than in the hands of NIH? From my experience on review panels at two universities for intramural funds, the performance of peer reviewers in local committees is not different from that in NIH committees.

PAUL Y. SZE

Professor of Pharmacology
and Molecular Biology
Chicago Medical School


AS LONG AS THE ENJOYMENT OF
OYSTERS IS NOT RESTRICTED TO THE
DINING ROOM TABLE ...

There will always be a
CHIVAS REGAL.



MIT Reporter

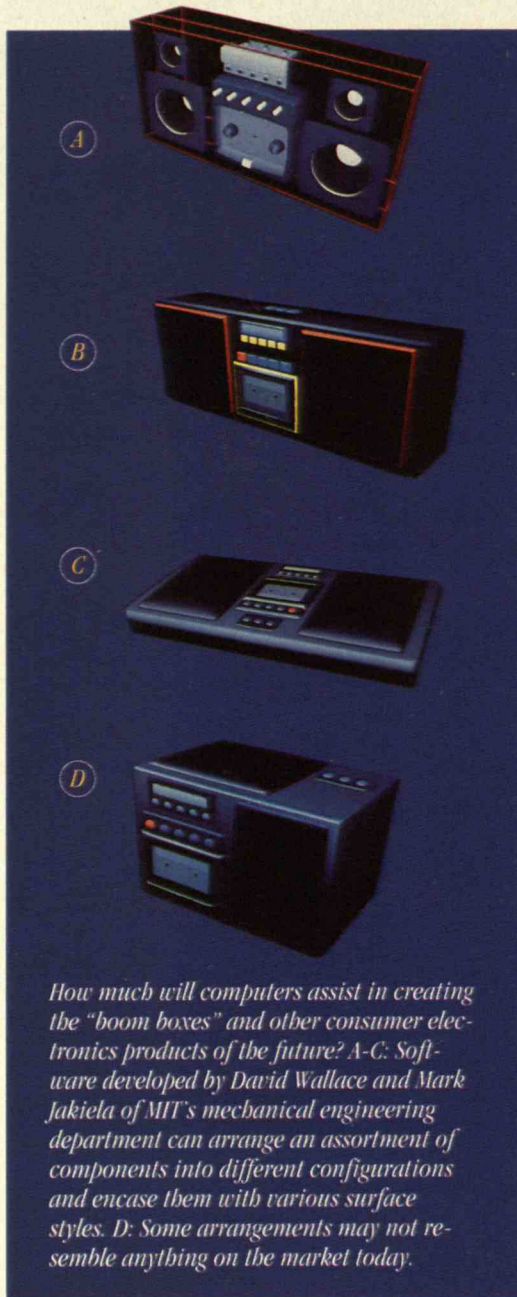
COMPUTERIZED PRODUCT DESIGN

 The computer is transforming the world of industrial design, with sketch pads and clay models giving way to the workstation graphics of computer-aided design systems. But while today's CAD systems allow designers to record and present their choices for products, they do not actually generate alternative designs. Now David Wallace, an MIT mechanical engineering doctoral student, is creating software for producing a variety of options. The program, geared so far to consumer electronics products, considers everything from manufacturing factors to aesthetics.

Wallace expects that the system, which he is developing with Mark Jakiela, assistant professor of mechanical engineering, will reduce the time needed for shuffling plastic-molded products back and forth between engineering labs and design shops. "It's a negotiation process that can consume enormous amounts of time, even for very simple products," says Wallace.

To use the system, engineers or designers specify the components of the product they want to make, such as the speakers, controls, and cassette-tape drive of a stereo. They also indicate the basic attributes they want the product to have, such as whether it is to be handheld. Then, because the product will be made by injection molding, they note the axis along which it is to separate.

The program arranges the components into various configurations, guided by established principles of organization, such as stability and aesthetic composition. System users choose the arrangement they like most and instruct the software to encase it in a box with a surface style selected from



How much will computers assist in creating the "boom boxes" and other consumer electronics products of the future? A-C: Software developed by David Wallace and Mark Jakiela of MIT's mechanical engineering department can arrange an assortment of components into different configurations and encase them with various surface styles. D: Some arrangements may not resemble anything on the market today.

the system's library. The system also adds external details like buttons, lettering, and colors that work well with the style.

While test runs of Wallace's system have yielded some designs that match the standard ones used for "boom boxes" and handheld calculators, they have also produced different configura-

tions, such as a cube-shaped boom box. After all, the software has no idea what a particular product should look like. But by presenting an array of possibilities, the system gives designers and engineers interesting options that otherwise might not be apparent, says Wallace. And the program affords immediate comparisons.

Ron Hill, chair of the Industrial Design Department at the renowned Art Center College of Design in Pasadena, Calif., acknowledges that in his field computers are a "powerful and valuable tool." He worries, however, about a style dictionary. "It certainly can't replace the individual who comes along and challenges existing styles."


But the objective, Wallace explains, "is not to totally automate design. It is to assist the designer." Wallace intends for designers to create and continually update their system's style libraries. "Ultimately," he says, "we would like designers to be able to sit down at the system and tweak the style knobs" to come up with a broad range of options. They could then "quickly decide which ones are worth exploring further."

Woodie Flowers, director of MIT's New Products Program and an outspoken commentator on the need for integrated design and engineering, says that tools like Wallace's will enable "industrial designers to take the drudgery out of their work and let them focus on the rich intellectual

activity of design." He is quick to add that "no one should take the output of any computer program and then just manufacture several million copies of a product." Industrial design, according to Flowers, should remain a human enterprise.

—DAVID BJERKLIE (*The author is a science reporter for Time.*)

GENETIC DAMAGE AND SKIN CANCER

 Blame tanning parlors, fun-in-the-sun lifestyles, and all sorts of skin-revealing modern fashions. The thinning of the ozone layer—our primary protection against ultraviolet radiation—and unknown chemicals in the atmosphere are also under suspicion. Whatever the reasons, the incidence of melanoma has been rising faster in the past few decades than any other cancer except, perhaps, lung cancer. Each year, more than 32,000 Amer-

icans are diagnosed with melanoma, and 6,000 die from this cancer, which is highly curable if detected early. that occur in skin cells that form melanoma tumors. Now Jane Fountain, a postdoctoral fellow in the lab, says she has found the rough location, on one of the 23 pairs of chromosomes found in every cell's nucleus, of a particular type of genetic damage that may help start the cancer formation process. While this is basic research, it could ultimately lead to doctors being able to provide a new type of therapy for melanoma.

At the Eighth International Congress of Human Genetics this past October, Fountain reported that cells in 13 of the 15 melanoma tumors she tested were missing



Too many days at the beach may play a role in the recent rise of melanoma. Basic research by Jane Fountain, a postdoctoral fellow at MIT's Center for Cancer Research, could ultimately enable physicians to provide a new type of therapy for the cancer.

icans are diagnosed with melanoma, and 6,000 die from this cancer, which is highly curable if detected early.

In the lab of biology professor David Housman at the MIT Center for Cancer Research, scientists have been investigating some of the many genetic changes

a stretch of chromosome 9, which combines with all the other chromosomes to direct every cell's function.

Based on other findings, the missing section Fountain has located appears normally to contain one or more "tumor-suppressor genes"—genes that regulate the growth and reproduction of the cell. Freed of normal regulation, the cell can divide fast and chaotically into cancerous offspring.

Since Fountain hasn't pinpointed specific tumor-suppressor genes in the missing stretch of chromosome 9, her next task is to search for the sequence of

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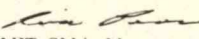
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genetic code that could make up the crucial area that regulates cellular growth and reproduction.

Not all scientists are convinced that this section of chromosome 9—or more precisely, its absence—plays a crucial role in initiating melanoma. Sherri Bale, a geneticist at the National Institutes of Health, says she did not find the same pattern of chromosome 9 damage in families with an inherited predisposition to melanoma when she looked for such damage several years ago. (About 10 percent of melanomas occur in such families.) Bale suspects that Fountain has found a gene that enables melanoma tumors to progress rather than one that sets them into motion.

Several chromosomes might be implicated early in the cancer process, according to Housman. In the “melanoma families,” some members may be born with one kind of chromosomal damage, and subsequent genetic changes then help tumors start growing.

In any case, identifying gene deletions and mutations that lead to melanoma could enable doctors to look for such signs. Individuals with damaged chromosomes could be watched closely and urged to avoid the sun.

As for treatment, one strategy would be to restore any lost tumor-suppressor

genes to the melanoma cells and thus turn off the cancer process. While such experiments have been done in various laboratories on small numbers of cells, applying the idea to living tissue on a large scale is “more fantasy than reality,” Housman says. “The odds against getting every last cell” are simply too great.

Still, Housman points out, illuminating the genetic mechanisms that lead to melanoma offer potential places to intervene with therapy.

—RICHARD SALTUS (*The author is a science reporter for the Boston Globe.*)

PUTTING ENGINEERING IN CONTEXT



It's a thorny problem: students at MIT and other science and engineering schools are so busy tackling an expanding body of knowledge that they don't have time to learn much about the social context of their studies. Yet in their future work as scientists and engineers, today's undergraduates will routinely make decisions affecting many people's lives.

Since 1987, MIT faculty members have tried to expand and coordinate undergraduates' exposure to issues ranging from the environment to the

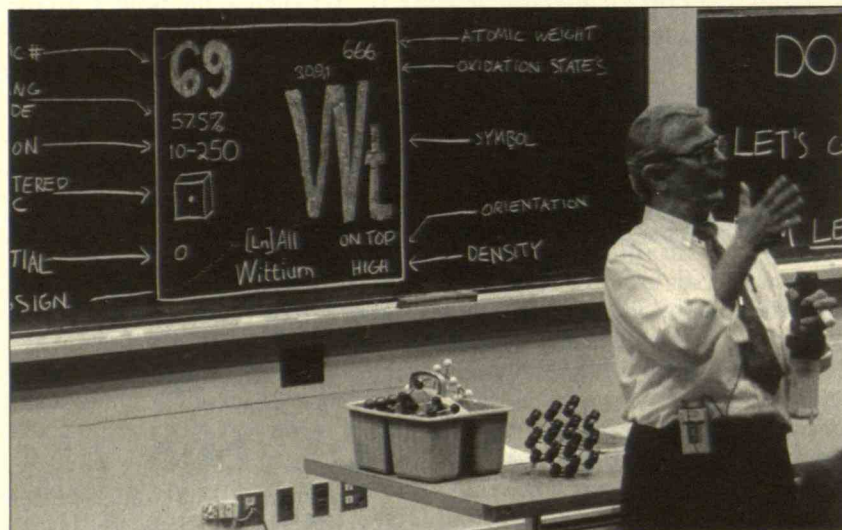
arms race through a program now called the Context Initiative. At first professors designed new elective classes, but most of those did not attract the 10 or 15 undergraduates desired for each course.

After 1989, when the program directors changed the focus to special seminars and other extracurricular activities, still only a handful of undergraduates came. “We felt that for all the energy we put into [the initiative], we simply were not getting the student response we wanted,” says Merritt Roe Smith, one of the program's two directors and a professor in the Department of Science, Technology, and Society.

This year, therefore, Smith, co-director Lawrence M. Lidsky (a nuclear engineering professor), and others at MIT are again pondering how to change the context program. Because of a new administration and the death of Margaret MacVicar, the dean for undergraduate education and one of the Context Initiative's highest ranked supporters, no official decisions have yet been made. But the general feeling is that students aren't likely to show up for events that do not satisfy one of their many academic requirements for graduation.

The belief that students were already overburdened was one reason program proponents originally did not want to require students to take a context course. Also, no department wanted responsibility for administering such a requirement, Smith says. “Faculty reaction was, ‘Out of whose hide will this come?’ It couldn't be resolved.”

Compelling students to study contextual material has made a difference at some schools, such as Worcester Polytechnic Institute (WPI). There, every student receives credit equal to three academic classes for completing a



August Witt, professor of materials science and engineering at MIT, inserts social-context information into his freshman course on solid-state chemistry.

required project that focuses on the interplay among science, technology, and society. Some students, for example, have worked with schoolteachers on new curricula and demonstrations geared to make math education more interesting. "The feedback from alumni has been wonderful," says Charles Kornik, who administers WPI's effort. Unsolicited comments from graduates suggest that as a result of the program, they feel "more sensitive to the people and world around them."

At least one course at MIT—an elective offered through the Mechanical Engineering Department that addresses ethical questions in engineering—tries to imbue students with a similar appreciation for the working world. Caroline Whitbeck, senior lecturer in mechanical engineering, says she designed the course so that

students would learn to come up with and choose from a variety of options when confronting ethical decisions on the job. In their main project for the class, students have to delineate an ethical problem that they may someday face, such as an engineering safety issue, and ask officials at one of 70 participating companies about how they would address the matter. Then the students speak with young employees who are also MIT graduates for the low-down on what actually happens.

While MIT's Smith is in favor of such elective courses, he believes they cannot reach as many students as do required courses that have integrated contextual material. For example, the freshman solid-state chemistry course given by August Witt, a materials science and engineering professor, offers contextual

information embedded in the basic science and engineering material. Witt ends each lecture with a 5- to 10-minute comment on a related note, such as the personal history of one of the scientists discussed in the class.

Smith and Lidsky think it might be possible to pay teachers to use time over the summer months to figure out how they can include "context" in their courses. Smith also says it would be a good idea to offer a workshop with this theme for professors. For now, the Context Initiative continues to publish and send to students and faculty a list of more than 100 courses that offer some contextual information. Margaret Enders, assistant dean for curriculum support, expresses hope that the document not only helps interested students but inspires more faculty. —GWENDOLYN FREYD

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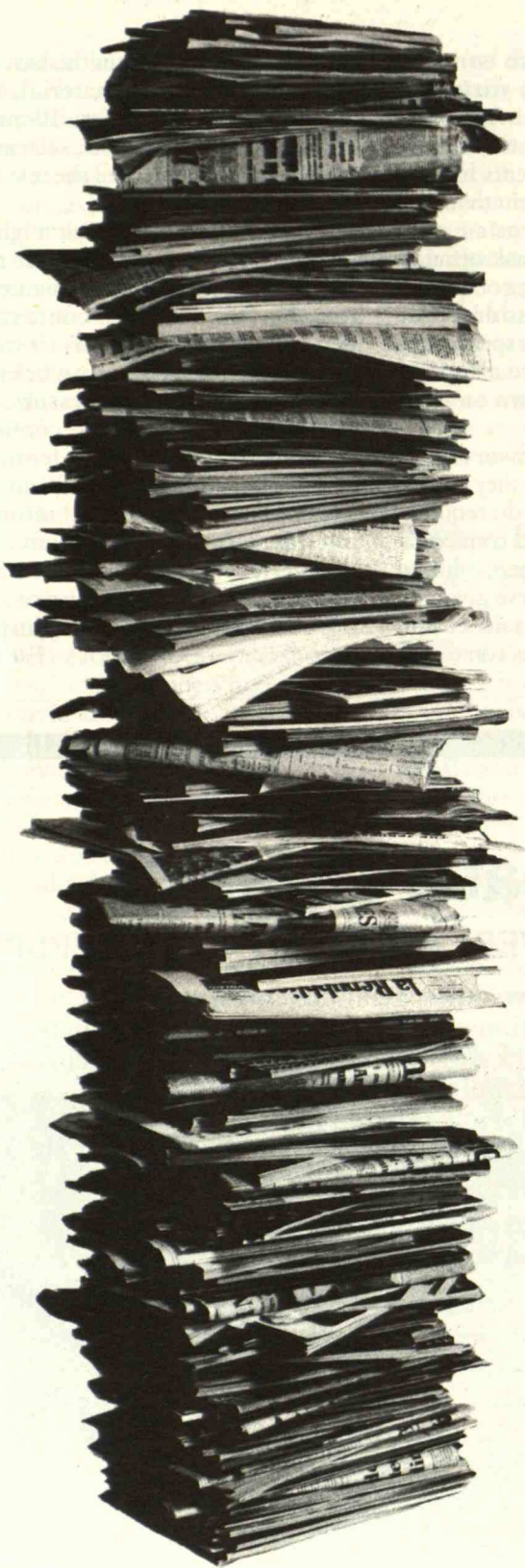
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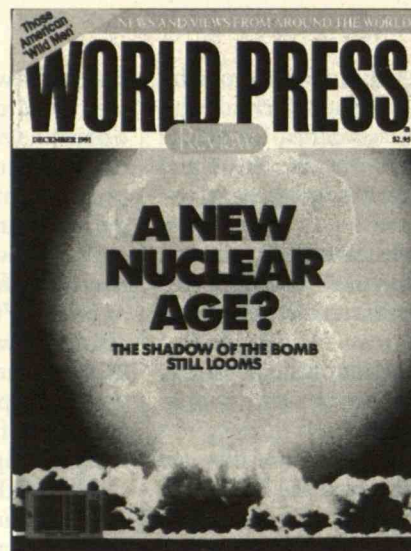
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Trends

Stalking Asian Software Pirates

■ The operation has all the ingredients of a network TV series. A crusading American lawyer works in exotic East Asian surroundings and flies from one city to another for short stints. Private investigators, informants, and lobbyists play supporting roles; police raids and long courtroom sessions expose cases with an annual sum at stake of billions of dollars.

Attorney Jeffrey Seibach is the leading man in the above scenario. Based in Hong Kong since he left private practice two years ago, Seibach serves as regional counsel to the U.S. software company Lotus. He is also vice-president of the Washington, D.C.-based Business Software Alliance (BSA), a collaborative effort among eight software companies. Since its formation in 1988, BSA's ambitious goal has been to eradicate international software piracy. Unfortunately, though, as Seibach explains, "The problem of pirated software grows as the use of computers grows in Asia."

One of Seibach's cases involves Ong Seow Pheng, a former accountant based in Singapore. The BSA alleges that Ong runs a hugely profitable business in illegally copied software from his home, purportedly selling software packages valued at \$600 for as little as \$15. "If I were a betting man, I'd say that he has sold several million dollars' worth of software," Seibach asserts.

In late October, after convincing local police that Ong was likely breaking Singapore's copyright laws, Seibach took part in a raid on Ong's home; the raiders seized a large number of boxes of documents pertaining to Ong's business, including many computer manuals believed to infringe the copyrights of Lotus, Digital Research, and Novell. Following another raid, the BSA obtained an injunction against Ong and his wife, restraining them from infringing the copyrights and trademarks of the three companies in over 40 separate soft-

ware programs. But ultimately, BSA wants more than restraining orders. "Our goal for Mr. Ong is incarceration," Seibach declares.

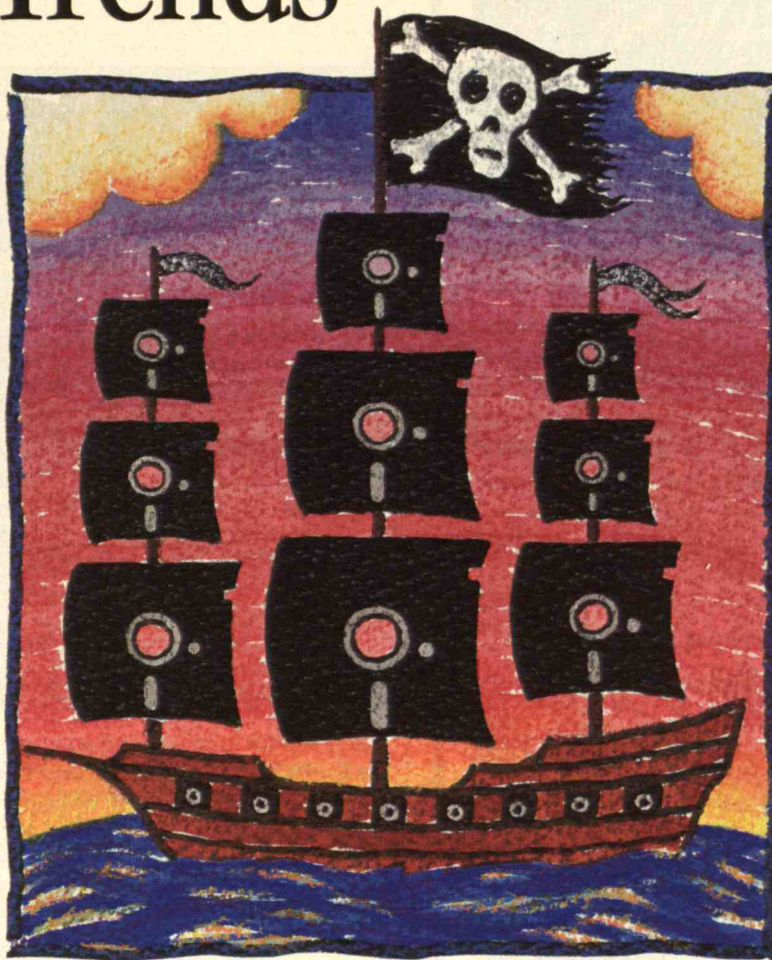
BSA officials say that while software piracy presents a problem everywhere, the emergence of Asia as an electronics and software capital of the world makes the scale of the problem in the region particularly alarming. The group estimates that worldwide piracy costs the U.S. software industry \$10-\$12 billion annually in lost revenue, with Japan alone accounting for \$2.1 billion of that total. No estimates are available of the losses caused by piracy in other parts of East Asia; BSA states only that they are substantial.

Who are the software pirates? Large-scale manufacturers like Ong Seow Pheng represent only a small but effective segment of the industry. Some groups of this type are known to be so sophisticated that they can corner the Asian market in new software packages

even before the packages are officially released in Asia. The result: when officially priced software is for sale, customers aren't interested.

Even more widespread are companies that buy one or two items of specific software and make hundreds of copies for their employees. BSA asserts that many multinational companies use pirated software throughout their organizations.

In November, for example, BSA members Lotus and Microsoft filed legal actions against Taiwan Hoechst, part of the German multinational conglomerate Hoechst AG, for suspected unauthorized copying and use of software, including Microsoft's DOS operating system and Lotus's 1-2-3 spreadsheet software. BSA estimates that two-thirds of the personal computers on the Hoechst site raided by Taipei police held suspect software. "Typically, the companies that we have taken action against have been and will be larger companies," BSA managing director Robert





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TRENDS

Holleyman told a symposium in Hong Kong in October. "Clearly, any company big enough to have people managing their information systems should be held accountable."

Similarly, Holleyman, Seibach, and the BSA plan to target computer dealers who download unauthorized copies of software to the hard disks of the computers they sell. Investigators suspect that such a tactic is used regularly to attract customers in several of Asia's major centers of retail computer sales, such as Hong Kong's Golden Arcade and Singapore's Funan Center.

Genuine Theft

BSA emphasizes that litigation is only one piece of an antipiracy strategy that also includes lobbying and education. In its lobbying efforts, the group tries to encourage the adoption of copyright protection laws in countries such as Thailand and Indonesia that lack effective ones. For that, BSA relies on help from local public relations firms and occasional pressure from U.S. embassies. For example, the BSA believes that trade pressure on the Chinese exerted by the embassy in Beijing resulted in the intellectual property laws that China adopted last year.

BSA admits that executives of many small Asian companies don't realize that they are breaking the law when they copy software. Copyright protection is still a fairly new concept in several nations. Hence the organization hires local consultants to run seminars for businesses that include specific informa-

tion about local software piracy laws. Seminar organizers say that a major difficulty is to persuade executives that software copying is a real crime. "There's a perception that software theft is like going 60 in a 55 miles per hour zone, as opposed to genuine theft," says Seibach. "This perception we have to overcome."

Software companies occasionally back up BSA's various efforts with technology. In some countries, they furnish their diskettes with copy protection systems that allow the diskettes to be copied only once. Sophisticated pirates have found ways to undermine such systems by opening up and re-writing files. But such systems do serve as a strong deterrent by making the copying of software much more difficult. Many software companies worry, though, that the protection systems make the diskettes appear slightly less "user-friendly" to would-be customers.

Meanwhile, the toughest part of the strategy is the litigation. BSA has to engage local law firms and solicit the cooperation of enforcement authorities even when valid copyright protection laws are on the books. In South Korea, where copyright laws have existed for four years, officials brought their first copyright action to court just several months ago.

In some nations, the BSA does not even bother to take cases to court. "We haven't undertaken litigation in Thailand because it wouldn't work," said Seibach. From BSA's perspective, China also remains a lost cause for now. Although the Chinese government announced a new copyright protection law in June, the bodies necessary to enforce the law haven't yet been set up. Nonetheless, the overall situation is improving, and the legal assault remains the main vehicle of software companies trying to capture Asian markets from the pirates. BSA says its effort has tripled or quadrupled in scale over the last two years, with 10 to 20 legal actions underway in nine different Asian countries. "In the past year, we've brought more cases than we've ever brought in Asia," says Seibach.—PETER GWYNNE



Jeffrey Seibach's goal is to recoup the billions in revenue that the U.S. loses to Asian software pirates each year. His strategy ranges from restraining orders to incarceration.

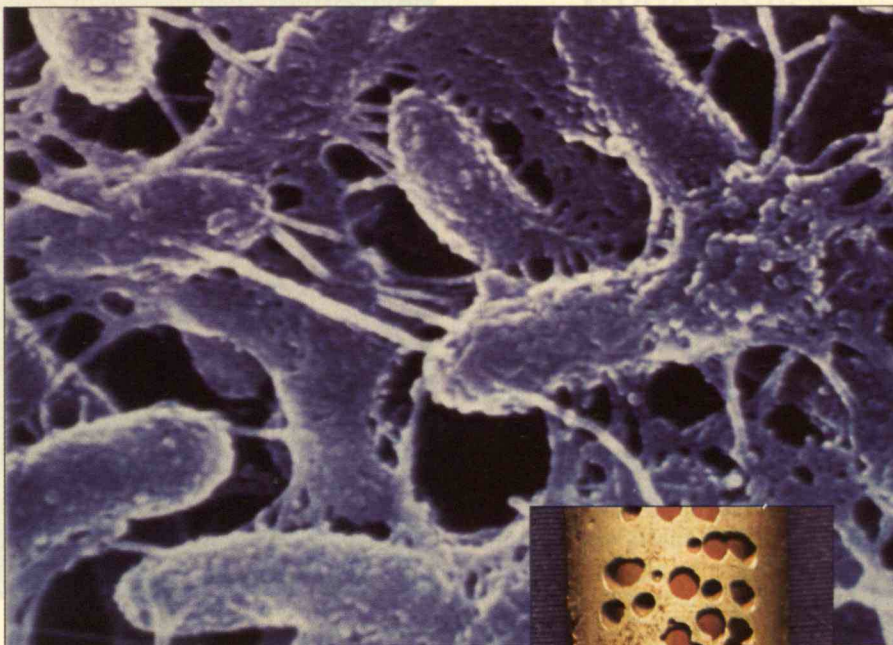
Scrutinizing Slime

The mere thought of sludge and slime inspires most people to reach for household detergents and cleaners. But now researchers have begun to investigate slime more closely—from the type inside pipes to the variety that collects on the surface of teeth and medical implants. These researchers contend that studying the way slime accumulates can lead to new methods for cleaning up toxic waste, improving oil-drilling operations, or leeching metals from ores.

Biofilms are colonies of microorganisms held together in a polymer-like mucus—a sticky outer web that can easily catch nearby debris. “Cells produce the slime in order to stick to surfaces and each other,” explains Christopher Wiatr, a microbiologist at Nalco Chemical Co., in Naperville, Ill. As bacteria wash down a pipe, for instance, they have only the scarce nutrients they travel with to subsist on. But if bacteria latch onto a surface, they can ingest whatever nutrients are carried to them.

The slime produced by the bacteria is a mixture of carbohydrates and protein, Wiatr says. Under a microscope, a slice of biofilm looks like an assortment of cells connected by strands of spaghetti. Over time, biofilms can become thriving collections of various kinds of microorganisms—virtual ecosystems—that live synergistically with others. According to Wiatr, a billion or more single-cell organisms can be found in a gram of biofilm sludge scraped off a pipe wall. Some of the microorganisms in the film may release ammonia; others might ingest the ammonia and release nitrates; still others might feed off dead cells.

Biofilms gradually clog pipes and help accelerate corrosion. European researchers attribute damaged masonry following winter frost to biofilms inhabiting the cracks. Medical patients, too, are endangered by biofilms. Bacteria in the bloodstream will adhere to pacemakers, catheters, or orthopedic implants. The buildup of biofilms can lead to infection, sometimes even forcing the removal of the infested implant. The



New research into “biofilms”—thriving colonies of bacteria (above) immersed within the sticky slime they produce—may provide insight into controlling their growth and the corrosion they can cause (right). In addition, biofilms might ultimately be harnessed to extract metals from low-grade ores.



body’s immune system, which ably hunts down and kills free-floating bacteria, often fails to recognize and attack the noxious intruders once they transform into a biofilm. And while antibiotics can kill most of these organisms in a petri dish, the bug killers are often ineffective against biofilms inside the body. The biofilms’ sticky webs seem to diffuse antibiotics, rendering them useless.

Some biofilms exhibit other perplexing characteristics as well. For instance, *Pseudomonas aeruginosa*, an organism involved in cystic fibrosis, will produce extracellular mucus inside the lung, but normally won’t do it in the laboratory unless cultured from a diseased lung, says Ananda Chakrabarty, a professor at the University of Illinois in Chicago. Other bacteria will express their film-making genes in an artificial environment only until they are subcultured. As Wiatr explains, succeeding generations of bacteria apparently find little reason

to exude the sticky substance. Moreover, while practically all microorganisms can stick to a surface to some degree, some stick better than others. We simply don’t know enough about biofilms, Chakrabarty says.

Benefits of Biofilm

Researchers have stepped up their investigations of biofilm processes over the last few years, holding numerous interdisciplinary meetings on the topic around the world. Moreover, funding for biofilm research is on the rise. The

Center for Interfacial Microbial Process Engineering at Montana State University, a leading research group in the field, holds a five-year, \$7.5 million grant from the National Science Foundation to study biofilms. In 1991, the Center received an additional \$1.5 million in research funds from industries searching for ways to retard biofilm growth—a topic of keen interest to chemical, petroleum, health products, and paper companies.

While fundamental research into biofilms may lead to new techniques to control its growth, the same research will also help identify ways to use biofilms beneficially, argues James Bryers, director of the Center for Biochemical Engineering at Duke University. For instance, some U.S. mining companies use a microbial-assisted process to extract copper from low-grade ores, Bryers points out. In the process, the microorganisms loosen or solubilize the metals to facilitate their extraction. If more can be learned about perfecting the use of biofilms in these processes, they could be extended to recover other metals, such as uranium, silver, nickel, and gold—as well as to desulfurize coal. Petroleum companies envision the use of biofilms to plug up sites where water permeates oil-bearing formations.

Natural biofilm systems have long been used in wastewater treatment (the organisms adsorb and metabolize certain wastes); more recently specialized microorganisms have been used to clean up petroleum spills on water. But biofilms engineered to carry specific microorganisms could also be used to gobble up toxic waste. For regulatory reasons, biofilms may be more acceptable purveyors of such microorganisms than other methods that would allow the bacteria to spread more easily into the environment. Bryers's group at Duke University is working with a recombinant organism that will degrade trichloroethylene (TCE), a toxic cleaning solvent that cannot be broken down easily in nature. They have also worked with an organism that will clean up certain kinds of herbicides. —TOM KIELY



Converting Subic Bay

During flights of fancy, Filipinos imagine a new city rising on the site of the Subic Bay Naval Base. They see a veritable Hong Kong in Central Luzon, complete with modern port facilities, a commercial airport, and new high-rise office buildings. But planners and policymakers know they face a far more mundane and difficult task in converting the sprawling naval base to a viable commercial outpost following the departure of U.S. forces this year.

Officials in the Philippines, like their counterparts in Germany, the United Kingdom, South Korea, Latin America, and other areas that have hosted U.S. military bases for decades, now face an unprecedented cutback of U.S. forces that is expected to close one-third of all U.S. bases overseas. The Pentagon has already announced that it will shut down operations at more than 275 overseas sites, including at least 14 major bases, before the turn of the century. Everywhere the United States is leaving, officials are agonizing over the dislocation caused by its withdrawal. But the situation in the Philippines, like most host countries outside of Europe, is complicated by poverty: the steady capital flow and employment opportunities from U.S. military bases will be difficult to replace.

One of the most popular options for converting the Subic Bay Naval Base for non-military use—once the U.S. departs this year—is to transform the facility into a commercial shipyard and port that could attract new industries to the Philippines.

Subic Naval Base and nearby Clark Air Base (which the United States decided to leave after it suffered severe damage from the volcanic eruption of Mt. Pinatubo in June 1991) have been in operation since the turn of the century. Both bases buzzed with activity during the Vietnam War. Subic, currently the logistical hub of the U.S. Seventh Fleet, served as an important transfer point during the recent Persian Gulf War.

Over the years, Subic has become important to the Philippine economy. According to the U.S. Navy, Subic employs more than 41,000 Filipinos and infuses more than \$305 million into the local economy through wages and purchases. Philippine economists say Subic, Clark, and the network of smaller U.S. military outposts in the country have provided up to 8 percent of the nation's gross national product.

But some critics believe the bases have actually hurt the economy and social situation. They say the bases have worked against economic diversification, promoted a black market, and contributed

to the spread of prostitution and sexually transmitted diseases; an estimated 15,000 women work as prostitutes in the 400 bars, discos and massage parlors near Subic, for example. And, say the critics, the prospect of continuous U.S. aid offered policymakers a false comfort because the funds did little to spur development. "We have had the American bases here for a very long time, but progress never came," Jose Concepcion, a business leader and former Secretary of Trade and Industry, told *National Midweek*, a Manila magazine. "So we must now chart our destiny alone."

Potentials and Obstacles

Filipinos have drafted several plans for converting Subic to civilian or mixed civilian/Philippine military use. "The commercial potentials are incredible," observes Solita Monsod, an economist at the University of the Philippines and former director of the nation's Economic Development Authority. Monsod suggests a few strong steps will be enough to raise money for conversion. These range from improving tax collection to selling the prime Manila real estate now occupied by the Philippine military (forces would move to Subic and Central Luzon).

Meanwhile, a government-appointed commission headed by Jose Abueva, president of the University of the Philippines, recently released a formal conversion study, offering a range of options from distributing the base's land among poor farmers to developing an industrial complex. The option that has generated the most attention calls for converting the core of the base to a commercial shipyard and port that could serve as a magnet for new industries. Subic's vast port, large enough to accommodate 25 ships, is equipped with dry docks, ship repair facilities, storage areas, and huge cranes that can load and unload 20 tractor-trailer-sized containers per hour.

Alex Magno, political scientist at the University of the Philippines who contributed to the Abueva report, believes a new port and satellite assembly plants

could serve the Philippines and the booming economies of its Southeast Asian neighbors. Magno and other advocates say Subic's assets could be converted to a commercial shipyard competitive with regional facilities in Singapore, Bangkok, and Hong Kong.

The conversion plan recommends turning the center of the shipyard into a state-of-the-art ship repair facility housed in existing buildings and dry-docks. Clients might include domestic and international shipping firms and navies such as those of the U.S. and other friendly nations. But skeptics, including some U.S. State Department officials, point to competition from existing facilities, the Philippines' poor track record on economic development, the financial burden imposed by the eruption of Mt. Pinatubo, and uncertainty about foreign financing. In particular, they cite the poor performance of a Philippine-run ship repair facility near Subic Bay.

One further obstacle to any conversion plans is the fact that it remains unclear what facilities the Philippines will keep when the United States leaves. A 1988 agreement between the two countries assigned ownership of all permanent structures, such as buildings and wharves, to the Philippine government. But earlier agreements describe removable equipment, including cranes, as U.S. property. Which assets at Subic are "removable" and which are "permanent" will be determined during future talks. Thus the ultimate cost of any conversion plan will depend heavily on what the United States leaves behind.

The negotiations are complicated by recent Philippine discontent over U.S. military presence. In September 1991, the Philippine Senate rejected a U.S. proposal to withdraw gradually from Subic over the next 10 years, voting instead to require the Navy's departure by 1994. Finally, in December, during talks to set terms for the U.S. departure, the Philippine government demanded that the U.S. withdraw by the end of 1992.

—JAMES B. GOODNO (*author of The Philippines: Land of Broken Promises, Zed Books, 1991*)

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Ecological Restoration

While the environmental movement historically has focused on minimizing damage to natural resources, a growing number of activists, field scientists, and public policy experts have begun to argue that protection and preservation alone are not enough. What is needed now, they say, is a way to put ecosystems back together after they have been changed, damaged, or even destroyed altogether.

Inspired by this new sensibility, ecological restoration projects are springing up around the country. There are efforts to renew tall-grass prairies in the Midwest and to restore coastal wetlands in California and the Northeast. In Florida, federal agencies, including the Army Corps of Engineers, have embarked on a \$700 million, ten-year restoration of the Everglades. Most restoration projects are much more modest in scale than that, but many may have potentially widespread significance as pilot programs.

One such effort is the Island Reclamation Project, initiated by Rutgers University biologist Steven Handel. With the help of the Hackensack Meadowlands Development Commission, the town of Kearny, New Jersey, and a \$96,000 grant from the Schumann Foundation, Handel is trying to turn 16 acres of old Kearny landfill into a woodland ecosystem. If successful, the project will provide a model for the reclamation of the 2,000 acres of landfill that flank portions of the New Jersey Turnpike. And with 6,000 municipal landfills nationwide, the project has attracted interest outside the state as well. Most notably, the managers of the Fresh Kills Landfill in neighboring Staten Island, New York, have called Handel about the prospects for rehabilitating some portion of their site, well known as the world's largest garbage dump.

Invasion Potential

Roughly three years ago, Handel became interested in the restoration project when he noticed during field trips

Landfill managers, such as those at the world's largest dump at Fresh Kills in Staten Island, New York (above), have expressed interest in Rutgers biologist Steven Handel's method of trying to turn ruined lands into flourishing woodland ecosystems.

with students that defunct "landfills do not develop as would be expected into normal woodlands." Just as islands are surrounded by ocean, he explains, landfills are often encircled by suburbs and highways, cutting off most sources of seeds other than a few wind-blown species. Fruit-eating birds, essential to woodland development for their help in spreading seeds, have no reason to go to a landfill since there are no food sources or safe places to perch. Therefore, a key part of Handel's restoration experiment is planting species that will attract birds and other seed-dispersing vertebrates.

"We thought if we could get over the dispersal problem, we could initiate the whole process of woodland succession," Handel says. With the help of postdoctoral fellow George Robinson and a few

graduate and undergraduate students, Handel planted several hundred young trees and shrubs at the Kearny site. The eight species they chose reproduce quickly, generate a lot of seeds, and—with one exception—are dispersed by fruit-eating birds. The team also planted six species of wildflowers whose seeds are dispersed by wind.

Before any planting could be done, Handel first had to upgrade the soil from the construction rubble, rocks, and clean fill that had been used to close the Kearny landfill 25 years earlier. A contractor digging the foundation for a new building in Manhattan offered a partial solution. He had several thousand pounds of clean, good-quality soil to dispose of, and Handel had just the place to put it. To boost the soil's organic content, Handel brought in composted leaf mulch that the town of Teaneck, New Jersey "had sitting around and didn't know what to do with." In all, Handel supervised the application of some 5,000 truckloads of topsoil and mulch. The site was then seeded with quick-growing grasses to prevent erosion, and a simple irrigation system was installed. The site will be monitored for the next 3 years, and the entire life cycle of plants, from pollination to establishment of a restored woodland environment will be scrutinized.

Handel expects this research to yield both scientific and practical information. For population ecologists, the experiment will answer some basic questions about the so-called invasion potential of woodland species and whether it is possible to stimulate woodland development in a degraded area. Municipalities will learn the most cost-effective way to restore native vegetation once a landfill has been closed. Handel warns, however, that such a technique cannot restore damage to soil or groundwater from a hazardous-waste landfill.

"If we can show recruits surviving at a reasonable distance [from the original plantings] within two to three years, then we can say this part works," says Handel. If only certain species survive, he notes, they can adjust the seeding mix for future plantings.



The 15W Landfill in the New Jersey Meadowlands (top) exhibits the familiar lack of plant growth even 25 years after its closure. To prepare the land for restoration, a team from Rutgers applied some 5,000 truckloads of topsoil and leaf mulch to the site (middle). They then planted highly reproductive, fast-spreading species, such as black cherry trees (bottom), to maximize woodland development. The site will be monitored for the next three years.

At the University of Minnesota, restoration work on another kind of degraded environment is under way. Robert Noyd, a researcher in the plant pathology department, is working to bring back vegetation to the barren landscape left by iron-mining operations. For each ton of rock that is mined, some two-thirds are dumped back into the environment as waste. The result has been the accumulation of tailing piles as tall as trees, transforming thousands of acres into a lunarlike landscape.

Minnesota law requires mining companies to reclaim these areas, but efforts have been only marginally successful. The problem, says Noyd, is that many of the tailing piles consist of coarse particles that hold no water or organic matter. "These dumps are virtually sterile. There is no microbial activity, and fertilizer runs right through," he explains.

To compensate for the deficient soil nutrients, Noyd is looking at symbiotic microbes that can give plants essential nitrogen and phosphorus. "In a very stressful environment, plants can often colonize with the help of mycorrhizal fungi," he says. These fungi are found on most plant roots where they convert phosphorus into a form the plants can use; in exchange, the plant provides the fungi with carbon. In preliminary field studies where Noyd has introduced the fungi, he says he has evidence of "very extensive" root systems; similar plantings without the fungi have withered and died.

Noyd says that in the sterile environments he works with, "it takes time for any plants to take hold." Nonetheless, he maintains that his intent is not to recreate an entire forest or bog ecosystem but rather to get natural processes over a critical hump. Once a good plant base is established, other organisms can invade from the surrounding forests and bogs. Like Noyd, most restorationists recognize that reclamation is no substitute for preservation. "We have to stop degrading habitat," says Handel, but the question remains: "The land we have degraded—can we restore it?"

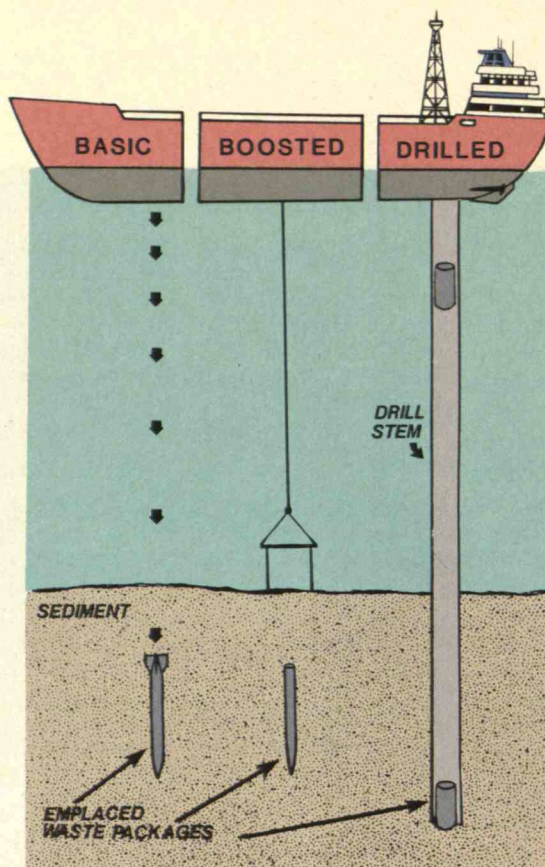
—TRACEY COHEN

Nuclear Burial at Sea

The problem of nuclear waste disposal may literally be "deep-sixed": the thick muds that carpet deep mid-ocean plains could be a permanent resting place for radioactive by-products. According to a plan proposed by a Woods Hole geologist, torpedo-shaped canisters containing the radioactive wastes could be dropped from ships. Plunging three miles to the ocean floor, the canisters could lodge 100 feet within the sea floor's muddy sediment and become sealed in a protective cocoon.

"If we put this stuff into these incredibly thick muds, it will be out of the biosphere forever, unless someone figures out how to reverse gravity," says Charles Hollister, a senior scientist at the Woods Hole Oceanographic Institute. Hollister's work with deep-sea muds in the early 1970s was central to a \$100 million international research effort on sub-seabed waste disposal. The 13-year research project, managed by the Organization for Economic Cooperation and Development (OECD), was intended to evaluate the prospects for building a permanent repository to be used cooperatively by all nations generating high-level nuclear waste. The OECD successfully coordinated the separate research efforts of eight countries on this project until 1986, when the U.S. government abruptly cut off its share of funding.

The U.S. Department of Energy is proposing to store an estimated 80,000 tons of accumulated radioactive waste at a land-based repository at Yucca Mountain in Nevada, but continued concerns over the safety of this arrangement are rekindling interest in seabed disposal. DOE has actually maintained an Office of Sub-Seabed Disposal Research, but it has not worked on the project since the department fixed its sights on land-based disposal with the passage of the Nuclear Waste Policy Act of 1986. The program has since languished without funding. The office's director, Walter Warnick, says that he has spent all his time for the past few years on global warming issues.



Firing a torpedo-shaped canister from the surface (the "basic" option) would bury nuclear waste packages 20 to 30 meters beneath the ocean floor. If greater depths are required, either a boosted or drilled emplacement mechanism could be considered.

like if you rub it between your fingers," Hollister says. The mud's tiny, negatively charged clay particles latch onto positively charged ions like strontium, uranium, and plutonium—some of the most dangerous elements in radioactive waste.

Studies by an international consortium coordinated by researchers at Sandia National Laboratory show that

these substances migrate through sea-floor muds more slowly than the mud accumulates in a slow, steady rain of decomposed organisms and fine silt. So if canisters leak their toxic contents, the radioactive elements would remain trapped in the mud and not diffuse toward ocean water and the food chain.

Most research so far has focused on a Texas-size piece of the ocean floor beneath international waters about 600 miles north of Hawaii. Although similar mud deposits cover roughly two-thirds of the ocean bottom, this particular site is an area of geological boredom, far from volcanic activity and tectonic plate movement. It is also largely untouched by undersea currents or the huge deep-sea storms sometimes observed in other parts of the ocean. A mud core drilled in the area by the international sub-seabed research group showed unbroken geological stability over the last 65 million years, making it far more stable than even the Department of Energy's land-based repository site in Nevada.

In theory, delivering radioactive wastes to precise spots on the sea floor

Geological Boredom

The mud-covered, abyssal, undersea plains in question are geologically stable and isolated from human and animal activity. The mud itself provides an extra chemical and physical barrier to the migration of any radioactive leakage. The thick, dark ooze is stickier and finer than the creamiest peanut butter, "closer to what melted Godiva chocolate feels

could be easily managed using existing or currently developing technologies, Hollister maintains. Satellite-guided global positioning systems already in routine use for navigation can direct a ship to within a few meters of a desired spot. Once there, the missile-shaped waste canisters would descend at 30 to 50 miles an hour into the ocean mud. Remote monitors attached to each canister would transmit information about its location, temperature, radioactivity, and integrity, says Hollister.

Opposition on Principle

Hollister is quick to acknowledge that much research must be done to determine if such a scheme is viable. He speculates, for instance, that the thick sludge will fill the hole a canister drills through

the sea floor so that no trail remains to the open ocean, but this has yet to be proven. The animals that inhabit the upper few feet of mud—tube worms, sea cucumbers and the occasional fish—must also be studied further to make sure that they couldn't somehow move radioactive chemicals into the food chain.

Even more important, researchers must determine the extent to which any accidentally released radioactive ions would bind to the deep-sea clays and the rate at which they might move up toward the water. A \$5 million experiment by the international group to inject small amounts of radioactive ions into the mud at different depths and track them for a few years was just being designed when funding for the entire project was cut off in 1986.

Such technical problems aren't necessarily the most difficult ones, however. Public perception and political issues will pose serious challenges to the project. Hollister himself points to the difficulties involved in managing and regulating a repository in international waters. Wherever it is sited, some environmental groups already oppose the sub-seabed disposal project on principle. "Two words—monitorability and retrievability—are our concerns," says Clifton Curtis, a policy and legal adviser to Greenpeace International. Keeping an eye on canisters embedded in mud miles beneath the ocean surface will be far tougher than if they were stored in a land-based repository, he says, and removing them if problems arise would be even trickier.

—P.J. SKERRETT

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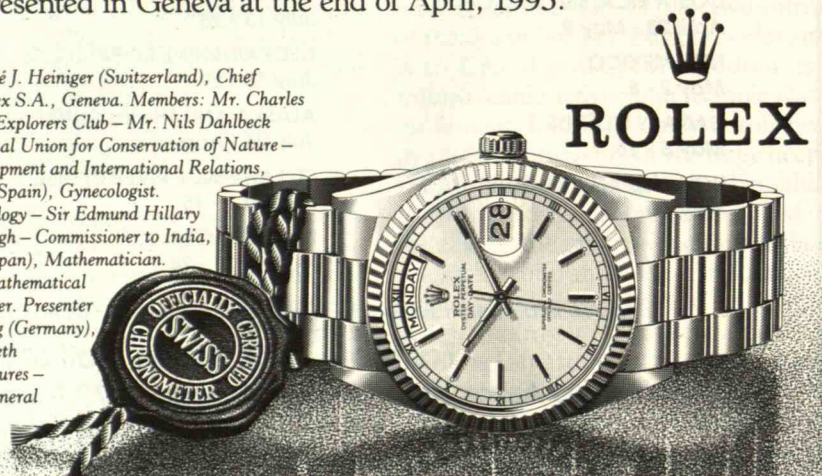
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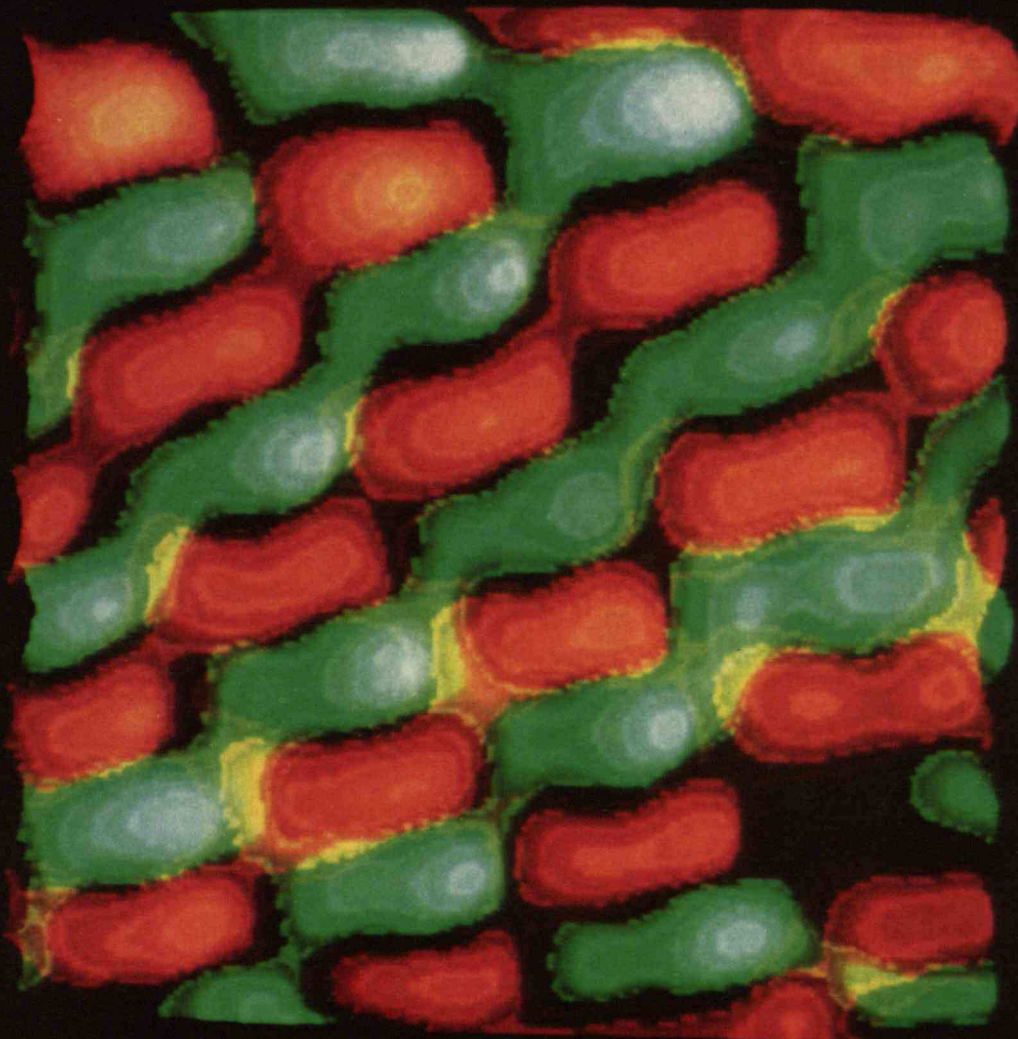
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BY STEPHEN S. HALL



Portraits of Atoms

*Recent images made with microscopes
that can observe atomic and near-atomic structures
show the instruments' growing value in fields
from computers to biology.*

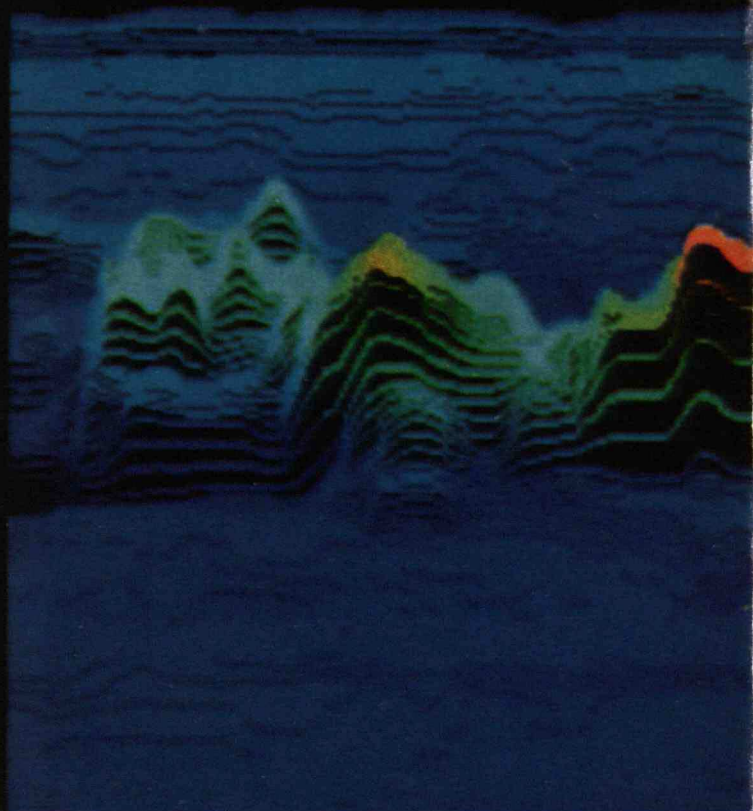
Sulphur (orange) and molybdenum (green) atoms contrast in an image made by a chemical-potential microscope—a device that can measure thermoelectric differences among atoms.

WHEN Randall Feenstra walks about his laboratory, he takes timid little steps. There's good reason why Feenstra, a researcher at IBM's Thomas J. Watson Research Center in Yorktown Heights, N.Y., is so careful. His scanning-tunneling microscope—a device that allows scientists to see atoms—is so sensitive that a heavy footfall, an indiscreet cough, even the warming beam of a flashlight will blur its vision.

Positioned inside the scanning-tunneling microscope's vacuum chamber is a needle sharpened to a point that is one atom in width. The needle rides across a prepared semiconductor surface, using an electric current to “feel” the surface's contours through a process known as tunneling. When the needle tip comes close to the surface, the atmospheric cloud of electrons buzzing around the nucleus of the tip's single atom begins to overlap the electron clouds of the surface atoms. Then, as a small current is applied to the tip, electrons flow—or tunnel—between the surface and tip. A computer picks up and converts the current's variations, which depend on the distance from tip to surface, into an image corresponding to the peaks and troughs of the surface topography.

Gerd Binnig and Heinrich Rohrer, two IBM researchers in Zurich, developed the scanning-tunneling microscope in 1981

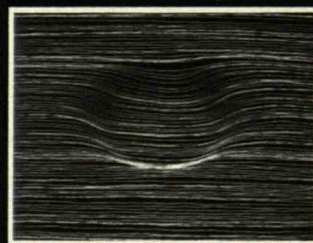
STEPHEN S. HALL is the author of *Mapping the Next Millenium: The Discovery of New Geographies* (Random House, Inc., © 1992 by Stephen S. Hall), from which this text is adapted. He has also written *Invisible Frontiers* (Atlantic Monthly Press, 1987), a popular history of the origins of genetic engineering.



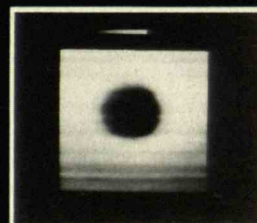
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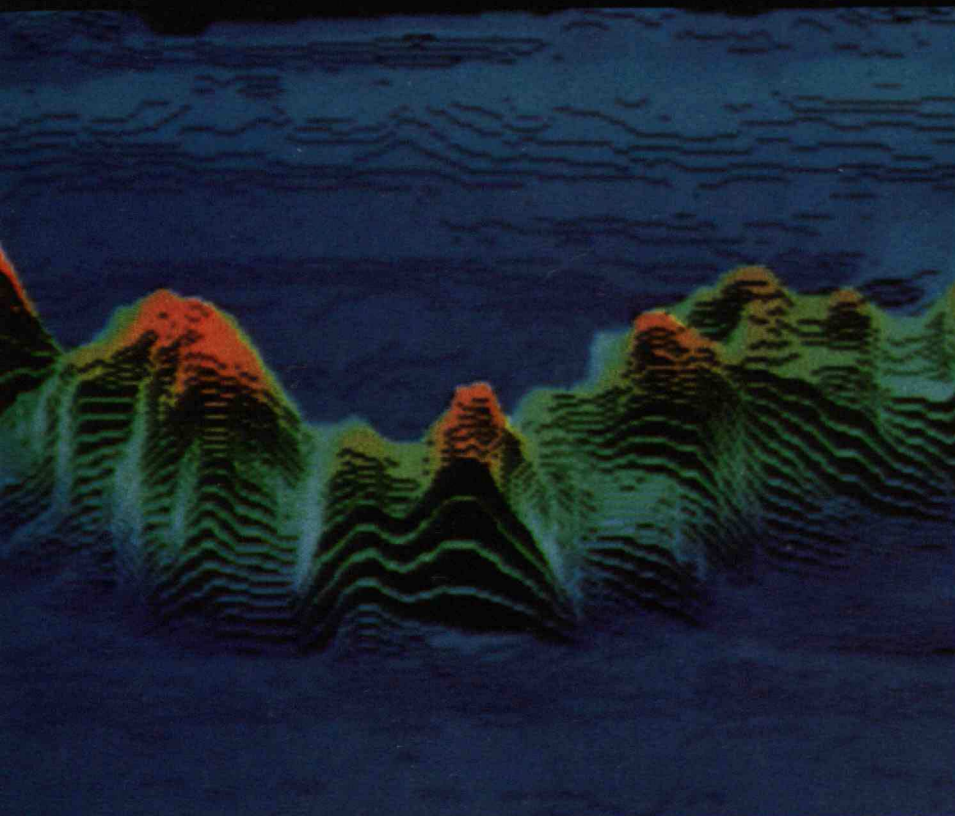


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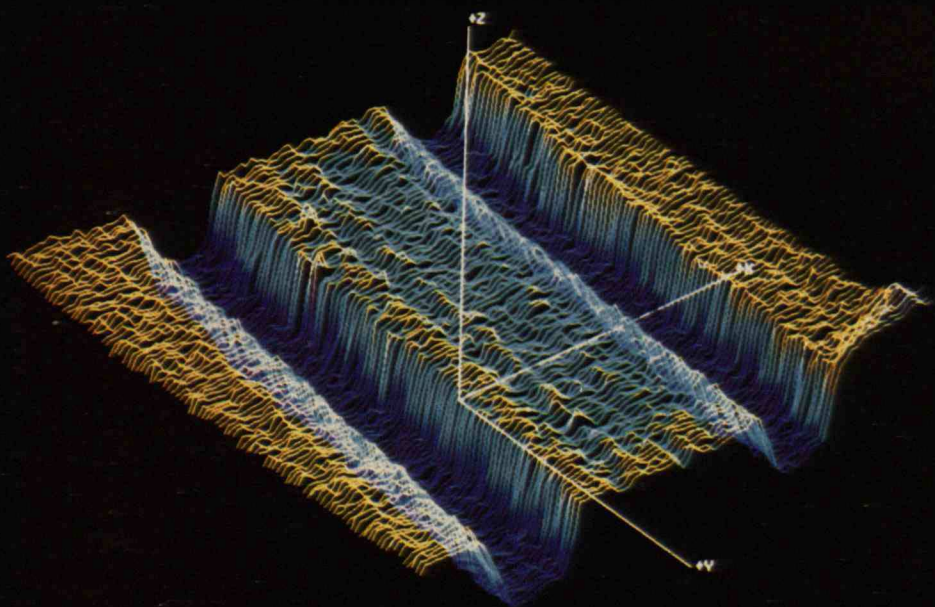


D





***R**esearchers are using a variety of scanning-probe microscopes to produce different images for different purposes. DNA's phosphate-sugar backbone has enough conductivity to be imaged with a scanning-tunneling microscope (STM); the waves in this 1991 picture (B) represent twists of the double helix. But scientists have also worked with the atomic-force microscope (AFM) to observe DNA (C). The front two "bills" in this AFM picture published last year are two of DNA's chemical bases. Given that bases (thousands of them) make up genes, scanning-probe microscopists hope that AFMs might help determine the makeup of the human genome. D: A magnetic-force microscope measured the different magnetic levels in a single bit written onto a computer's magnetic disk. IBM is using the microscope to study disk performance. E: This image of silicon dioxide "steps" on a slab of silicon (royal blue) was made last year using a near-field acoustic microscope, which sends sound waves through a surface to a collecting device on the other side and measures their amplitudes.*



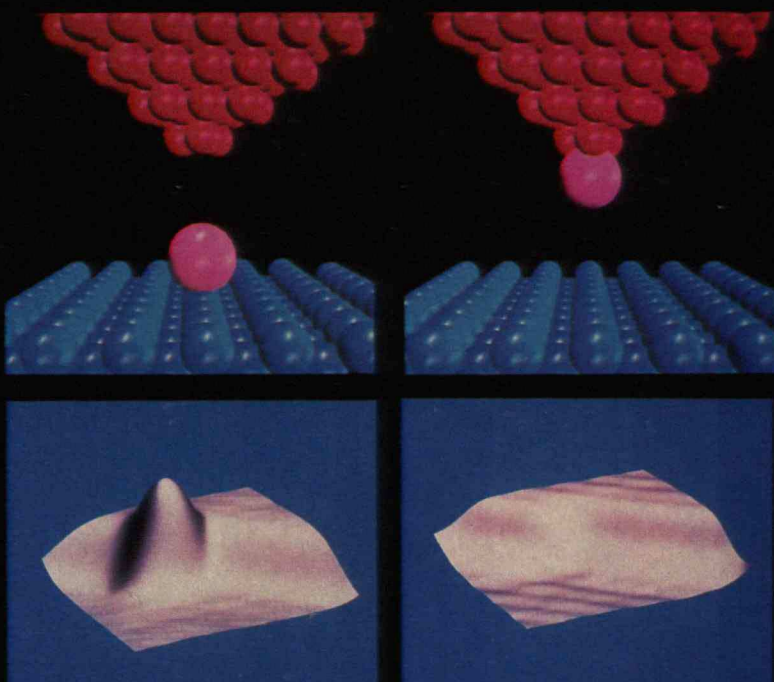
because they were interested in determining what the electronic structure of a semiconductor such as silicon looks like. For their efforts, they won the 1986 Nobel Prize in physics. Their device has spawned a host of related machines. The first was the atomic-force microscope, which visualizes any surface by measuring the extent to which its atoms' minute electrical or magnetic forces deflect an exquisitely sensitive tip. Other machines can detect, among other things, atomic-level friction, magnetic fields, temperature, sound waves, and the static electric charges that develop when two surfaces rub or touch.

Researchers have used these "scanning-probe microscopes" for a range of applications, such as mapping the magnetic field on computer discs and detecting the telltale coils of DNA. For fun, scientists have even picked up atoms and moved them elsewhere on a surface, like pieces on a chessboard. In the future, scientists hope to use the microscopes to continue mapping atomic surfaces, take the temperature of individual living cells, chart the landscape of cell membranes where nerve impulses are triggered, and help decipher human genes by discerning the specific location of the chemicals that make up the rungs on DNA's double helix.

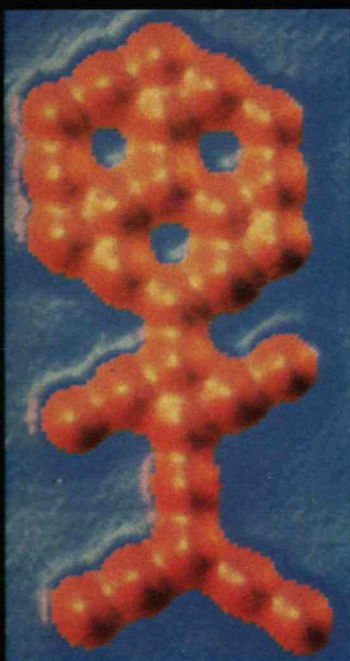
Paul Hansma, a physics professor at the University of California at Santa Barbara, has led scanning-probe microscope expeditions into biological territories. He recalls how, in the 1960s, a high-school science teacher told him that human beings would never be able to see atoms. Hansma compares the emotional impact of atomic images with the photos of the earth taken from space. "Everybody knew these surfaces had atoms, and how they were packed. But to see them," he says, is "enlightening in a way beyond words."



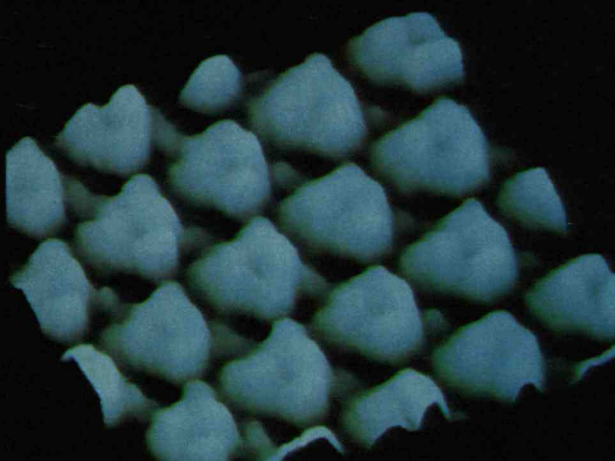
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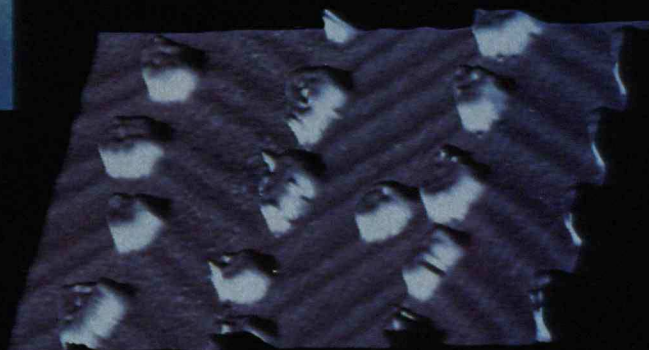
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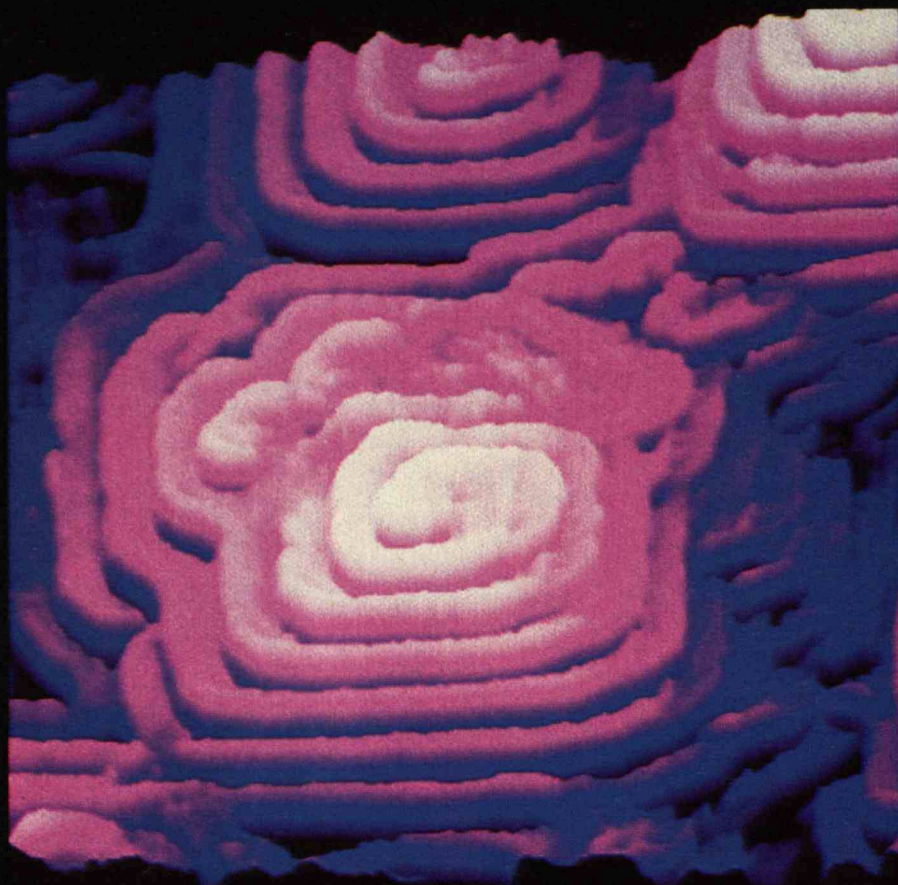


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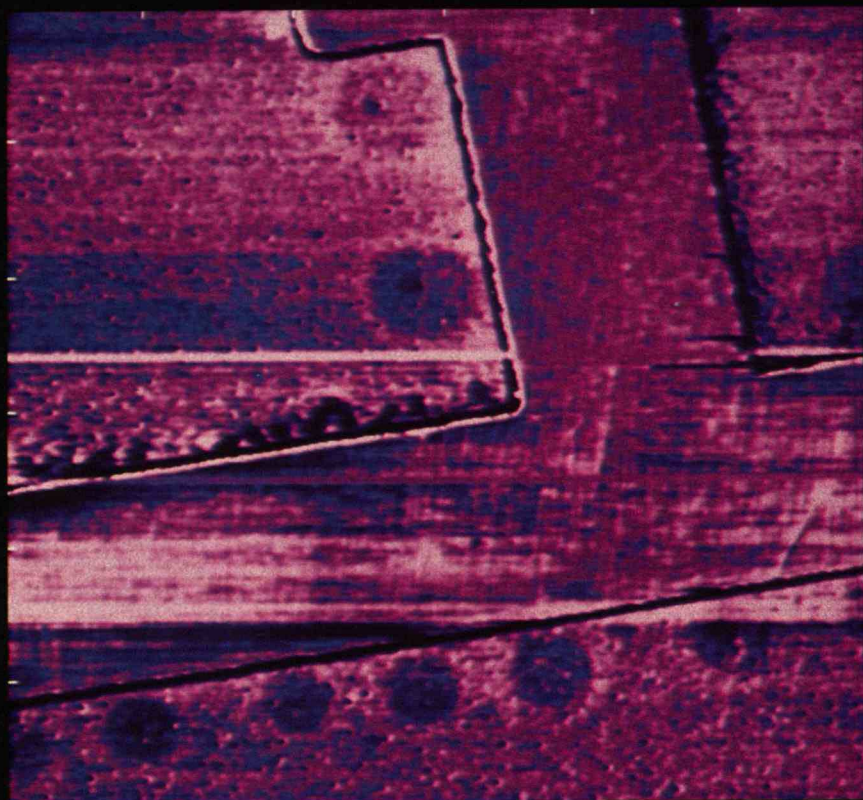


J

One of the first images to show molecules on an organic crystal surface was this 1988 AFM picture (F) of the amino acid leucine. G: For fun, IBM visiting scientist Peter Zeppenfeld used the scanning-tunneling microscope to pick up and redeposit 28 carbon-monoxide molecules to create this image on a platinum surface. A more serious technique involving the STM might lead to the creation of atomic-scale computer switches. This past year IBM research scientist Donald Eigler used an STM to rapidly and repeatedly pick up and redeposit a xenon atom in the same place on a nickel surface, establishing a binary, on/off "device." In the top two computer-generated images (H), a xenon atom first rests on a surface and then is picked up by an STM tip; the xenon atom is shown in pink and the tip in red. The bottom two pictures are STM images of the alternate states. I: An STM image shows that each benzene molecule is ring-shaped. J: In a 1991 STM picture, nickel deposited on gold first forms a regular pattern of islands on the gold's surface, which has a herring-bone configuration.

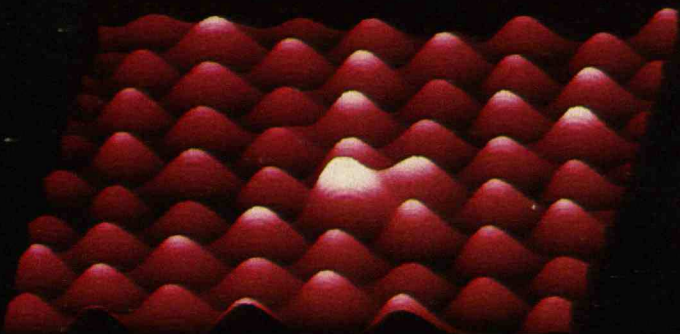
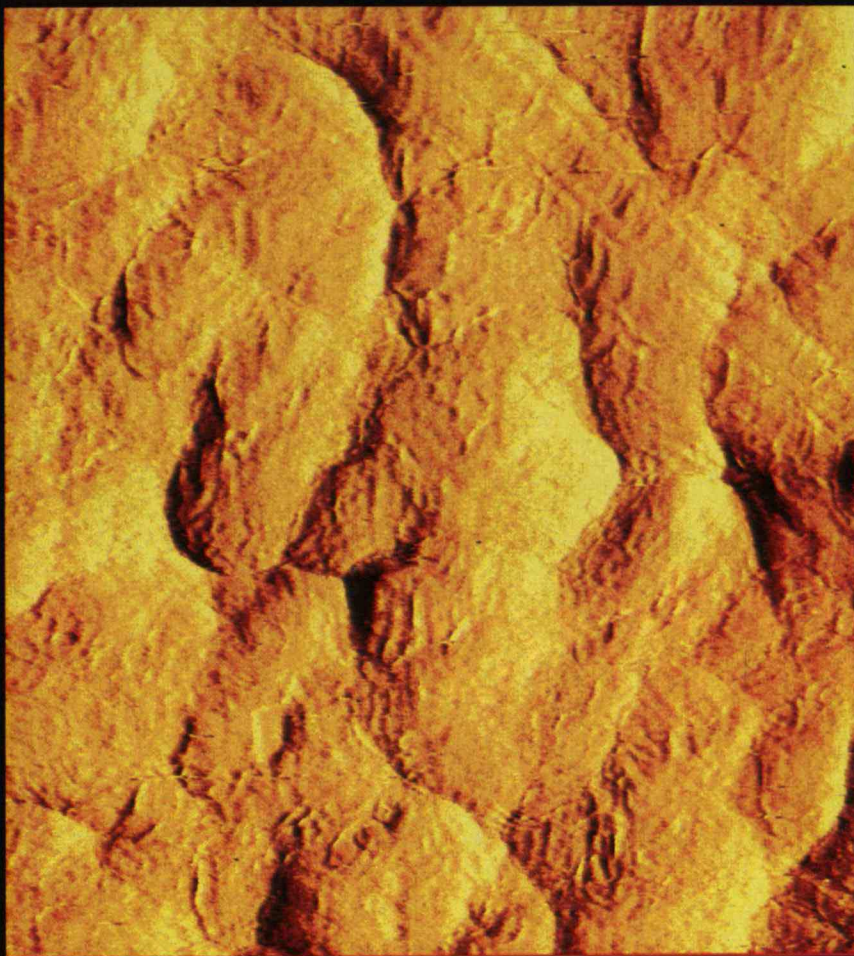


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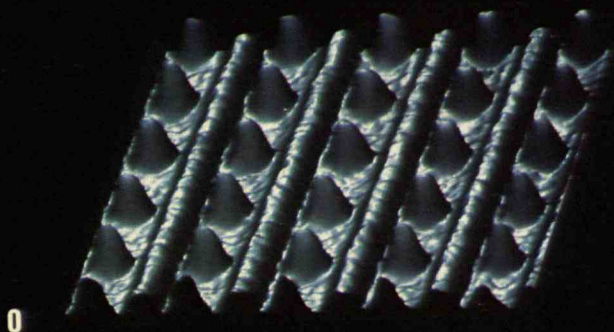


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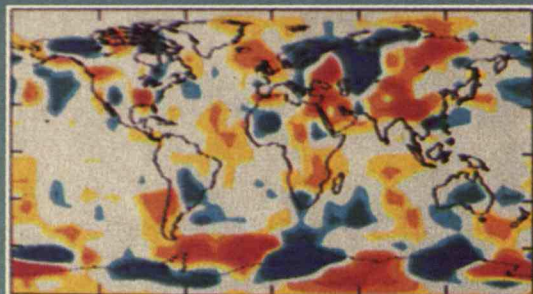
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Scanning-probe microscopes are finding a growing number of practical uses. **K:** An STM image reveals spirals in high-temperature superconducting film. **L:** Technologists working with a frictional-force microscope to image a photolithography mask—employed to make integrated circuits—found circles, believed to be water molecules, that have not been seen with other microscopes, according to Mark Rodgers, program manager of Digital Instruments. **M:** Texas Instruments is working with AFMs to image plastic tubing, which carries the purified water needed for producing computer devices. Small valleys indicate places where bacteria might grow. **N:** STM resolution is high enough to see a single-atom defect on a graphite surface, and hence could be useful in finding atomic-level problems in materials. **O:** An image of a stamper used in making optical disks (such as compact disks) indicates whether there could be manufacturing problems.

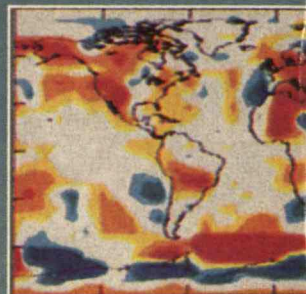
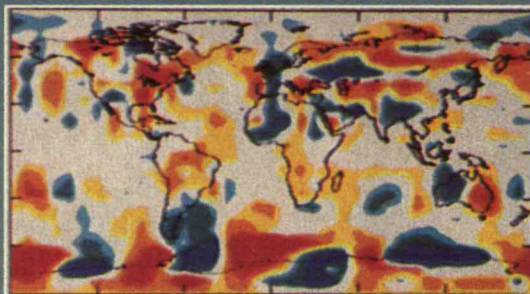
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JULY 1986



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Forecast Cloudy:

The Limits of Global Warming Models

BY PETER H. STONE

A report published in late 1990 by the Intergovernmental Panel on Climate Change (IPCC) warned that global warming could soon force temperatures higher than they have been in hundreds of thousands of years. The report, prepared by 170 scientists from all over the world, concluded that if the world's economies follow a "business-as-usual" scenario, increases in carbon dioxide and other trace gases in the atmosphere will cause the earth's average surface temperature to rise by about 5°F before the end of the next century. Such a rise would come on top of the warming of about 15°F that has already occurred since the last major ice age some 15,000 years ago.

The IPCC report was hardly the first attempt to assign a number to the effect of increases in trace gases. That

JULY 1990

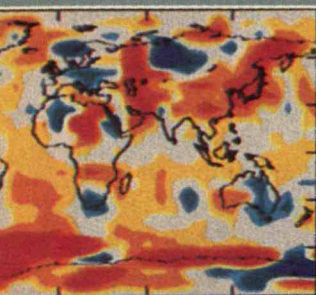


According to a climate model developed at NASA's Goddard Institute for Space Studies, most regions of the earth will be noticeably warmer by 2029 if emissions of greenhouse gases continue at expected rates. But like other models, the GISS projections do only a crude job of simulating small-scale climate processes and the effects of oceans, and hence are fraught with uncertainty.

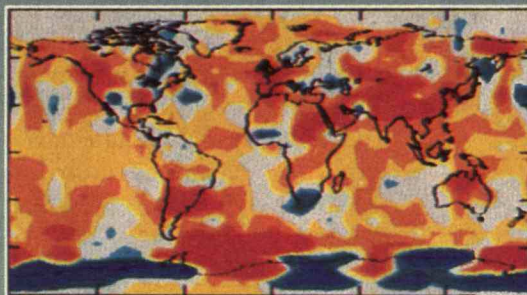
TEMPERATURE CHANGE (°C)



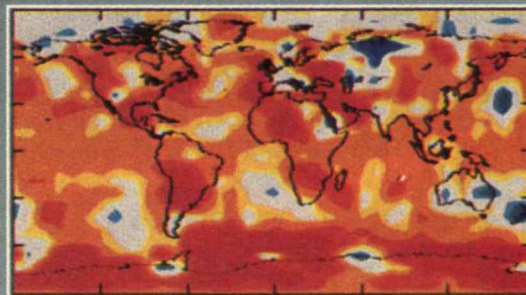
JULY 2000



JULY 2015



JULY 2029

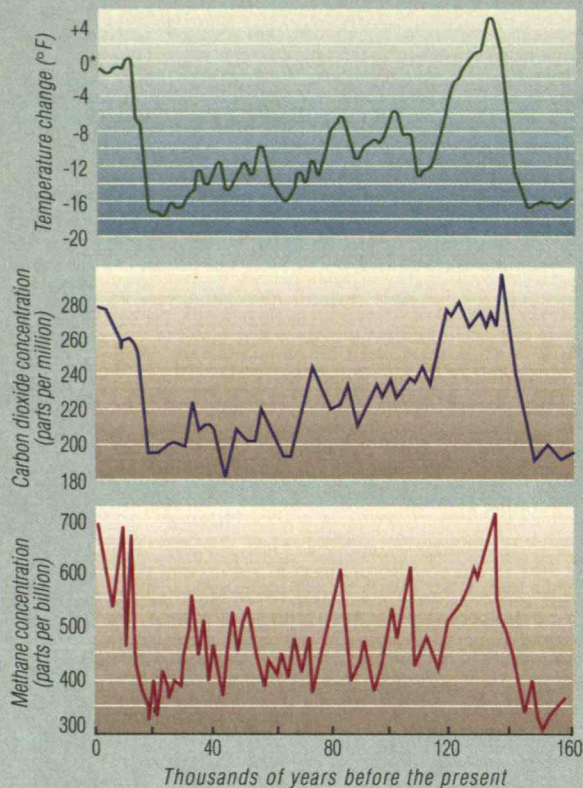


distinction belongs to the Swedish scientist Arrhenius who, almost 100 years ago, calculated that a doubling of CO_2 would cause a rise of 10°F . Since then, CO_2 doubling has become a standard yardstick for gauging global climate sensitivity. It is also a realistic yardstick, because current trends would produce a level of trace gases equivalent to a doubling of CO_2 by the middle of the next century.

The first modern estimate of the effect of CO_2 doubling was made in 1967 by Syukuro Manabe and Richard Wetherald at the National Oceanic and Atmospheric Administration's Geophysical Fluid Dynamics Laboratory in Princeton, N.J. The warming they predicted: 4°F . In 1979 a National Research Council com-

Predictions of climate change rest on models that are far from complete. But better observations, more powerful computers, and improved understanding can help us fill the gaps.

TRACE GASES AND TEMPERATURE CHANGE IN THE PAST



Some of the important greenhouse gases have fluctuated widely in the past because of natural processes that are not fully understood. These natural fluctuations, which have been associated with major changes in global temperature, could alleviate or aggravate global warming, but current climate models do not include them.

mittee chaired by Jule Charney of MIT, recognizing the uncertainties involved, estimated a range of values: 3°F to 8°F. The most recent estimates, including those by the IPCC, still fall within this range. In fact, considering that they benefit from supercomputers and other advances, it is remarkable that the latest predictions are not farther from the figure that Arrhenius arrived at in 1896.

At first glance, this rough consensus might seem to close the book on the issue of global warming: human-produced greenhouse gases such as CO₂ will cause a serious rise in global temperatures, and that's that. Indeed, the apparent robustness of these numbers is why most scientists believe that global warming is a serious threat. But we have much more to learn. The IPCC

PETER H. STONE, a professor in MIT's Department of Earth, Atmospheric, and Planetary Sciences and a member of the Institute's new Center for Global Change Science, has spent 20 years developing and working with climate models. He is part of the team that developed the Goddard Institute for Space Studies' general circulation model and applied it to the global warming problem.

report was quick to point out the many question marks in its predictions, especially regarding the timing, magnitude, and regional patterns of climate change. These uncertainties, common to all climate predictions, stem from the complexity of the physics involved and the coarseness of the models that struggle to simulate it.

A climate model consists of mathematical equations based on the fundamental laws of physics. Solving these equations—a task usually done on large computers—can determine how climate variables such as temperature, humidity, winds, and precipitation will respond to changes in factors like the amount of solar radiation reaching the earth, or the concentrations of trace gases in the atmosphere. The climate system is so complex, however, that a model incorporating all the possible variables for all parts of the globe could not be run on even the fastest supercomputers.

As a result, scientists use a wide variety of models to study climate and climate change. At one extreme are simple models that severely limit the number of variables they try to predict (forecasting only temperature, for example), or that severely restrict the physical and chemical processes they include (omitting, say, heat transport by ocean currents). At the other extreme are the large numerical general circulation models (GCMs) that include as many variables and processes as possible.

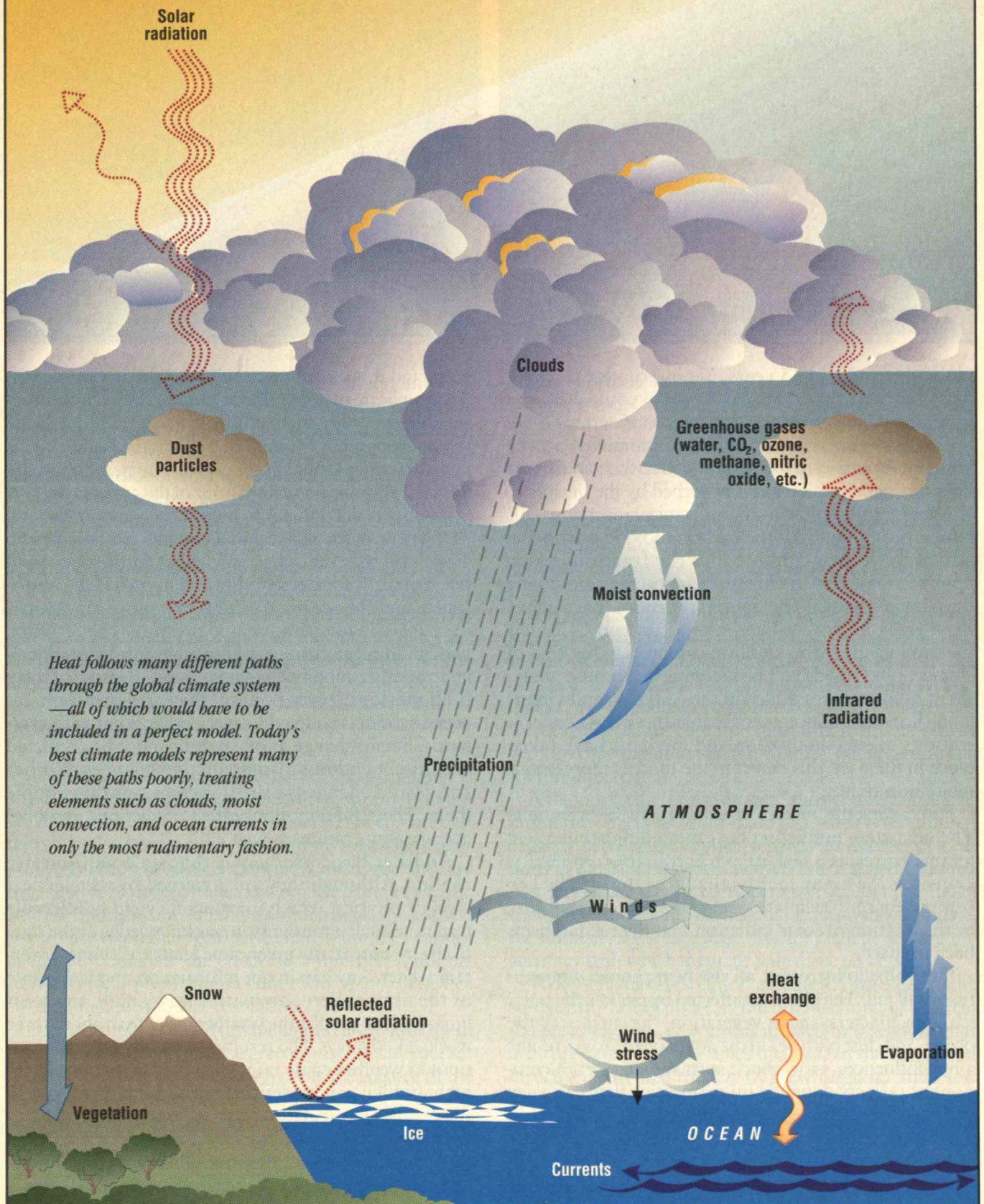
Because even these models are not truly comprehensive, the simple models play a valuable role in determining what variables and processes are important, thereby allowing scientists to improve the larger models. Also, there are many problems for which the large models are computationally too inefficient to be practical—for example, problems involving climate changes over hundreds of years. For this reason, the IPCC projections for the next century were based on one of the simplest models. Ultimately, however, only GCMs will be able to yield accurate predictions of changes in all the climate variables anywhere on earth.

A Complicated Planet

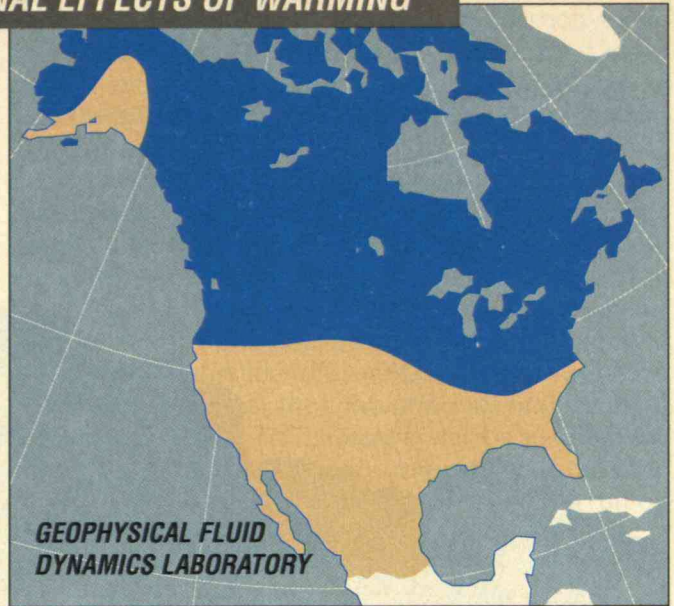
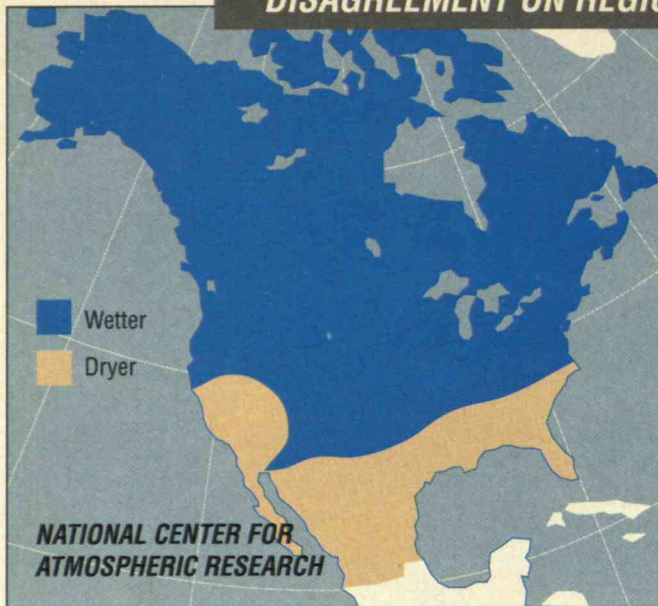
Modeling climate change is inherently difficult. To do so, climatologists must try to simulate the behavior of oceanic and atmospheric systems that are not only fantastically complex in themselves but intricately linked.

Just figuring out how fast greenhouse gases will build up is hard enough. The constituents of the atmosphere that absorb the most infrared radiation, and therefore contribute most strongly to the greenhouse effect, are water vapor and clouds. But other gases contribute as well, and their concentration in the atmosphere is growing, mainly because of human activities that are impossible to predict with certainty even in the short term. In the 1980s, for example, chlorofluorocarbons (CFCs) increased by 40 percent, methane by 10 percent, and CO₂ by 4 percent. At these rates, CFCs would replace carbon dioxide as the major contributor to increases in

THE GLOBAL CLIMATE SYSTEM



DISAGREEMENT ON REGIONAL EFFECTS OF WARMING



global warming in 25 years. Yet international agreements such as the Montreal Protocol could slow the increase of CFCs, altering the picture considerably.

There are also major scientific uncertainties about the buildup. A portion of the gases added to the atmosphere does not remain there but is absorbed by the biosphere and the oceans or destroyed by chemical reactions. This happens to about half the carbon dioxide now being added to the atmosphere, but the fraction that is removed may vary as climate changes, thus modifying the climate change. The natural processes that remove these gases are not well understood, and no GCM has tried to include them. Until we can predict this kind of change, our models will be incomplete. Because analyses of deep ice cores drilled in the Antarctic and Greenland show that major changes in atmospheric concentrations of carbon dioxide and methane have taken place in the past, this defect in the models represents a major uncertainty.

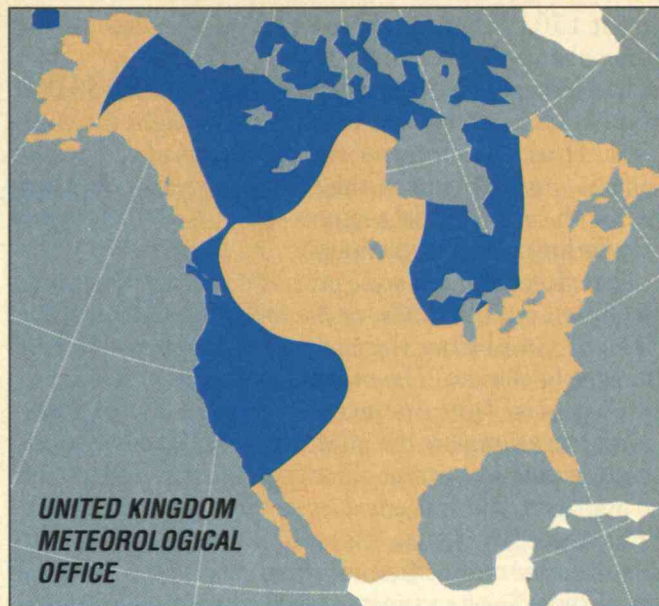
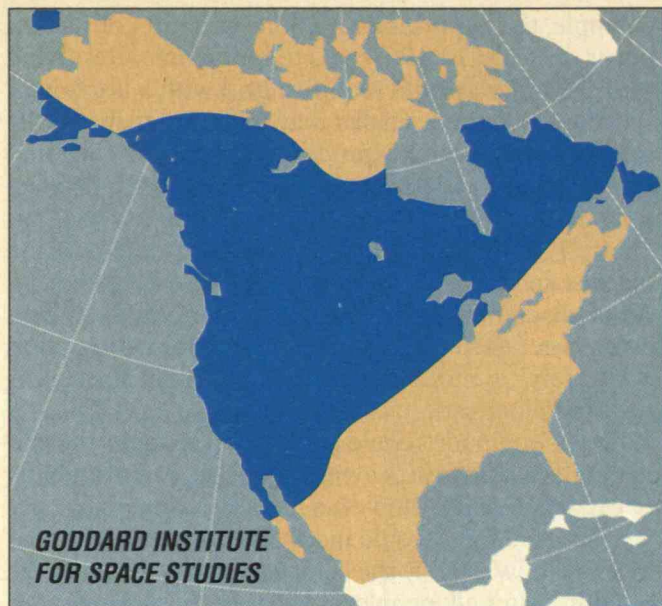
Forecasting the buildup of gases is only the beginning. The next step, predicting how the buildup will affect temperatures, is a task of extraordinary complexity. Consider the many factors that govern just one key component of the climate system: the planetary albedo, or the fraction of solar radiation that the earth reflects back to space.

If the albedo increases, all else being equal, temperatures will fall. The albedo is affected by clouds, the polar ice caps, glaciers, snow, vegetation, the surface of the ocean, and dust particles in the atmosphere, to name just a few influences. How much solar radiation each component reflects depends on properties that can vary widely—for example, the water content of the clouds, the composition of the dust particles, the age of the snow, the roughness of the ocean surface, and the health of the vegetation. In principle, all these details must be

predicted if one is to model climate change accurately. To complicate matters, albedo can be affected by unforeseeable events such as volcanic activity. Indeed, the recent eruption of Mount Pinatubo in the Philippines is likely to cause global *cooling* over the next few years until the volcanic particles fall out of the atmosphere.

It is especially difficult to predict the way climate will change in a particular region. For some regions, climate models do not even agree on whether temperatures will rise or fall. A fundamental problem is that the atmosphere and the oceans are fluids that move in response to changes in temperature and pressure. The resulting winds and ocean currents transport heat from one locality to another, modifying temperatures. Because of these fluid motions, every point in the earth-atmosphere-ocean system is coupled to every other point in the system. Climate change at one point cannot be predicted accurately without also predicting changes at other points and changes in the fluid motions that couple them. These fluid motions affect predictions of global average temperatures as well.

Another basic problem is that such motions are chaotic. Although they are governed by the classical laws of physics, which in principle yield predictable results, a small uncertainty in our knowledge of the state of the system at any given time leads to a large uncertainty later. Any gap in our information about the state of the atmosphere, no matter how small, makes it impossible to predict the weather more than about three weeks in advance. The resulting unpredictable fluctuations in weather cause unpredictable fluctuations in climate (which can be defined as the average weather). According to calculations carried out at NASA's Goddard Institute for Space Studies (GISS) in New York City, the chaotic behavior of the atmosphere can cause fluctuations of as much as 1°F over periods of about 30 years.



Although a “noise level” of 1°F is small compared with the projected warming of 5°F before the end of the next century, other possible sources of unpredictable behavior have yet to be assessed. For all we know, chaotic fluid motions in the ocean might produce unpredictable climate changes that are larger still. Indeed, unexplained fluctuations much greater than 1°F have occurred in the past, most recently about 10,000 years ago during the so-called Younger-Dryas cold interval.

Thus any effort to predict climate changes assumes that climate is predictable—but this is not guaranteed. Forecasts of the effects of a rise in greenhouse gases are really just predictions of what will happen in the absence of the unpredictable.

Problems of Scale

Calculating just the predictable part of climate change is still a formidable problem. This is not simply because we don’t fully understand the physics of the climate system; it is also because the “resolution” of today’s general circulation models is extremely low. Not only are they unable to differentiate between the climates of, say, Buffalo and Boston—a limitation that severely restricts our ability to predict regional climate—but they cannot accurately calculate the effects of a number of important physical phenomena that take place on scales smaller than the models’ resolution.

One example is clouds, which contribute greatly to the planetary albedo and the greenhouse effect. Another is moist convection, which both cools the surface of the earth and affects the concentration of water vapor. Also not resolvable are hydrological processes that affect the amount of moisture in the soil—an aspect of climate that is important for agriculture and water resources and that is likely to change as a result of global warm-

General circulation models contradict one another on how global warming will affect various regions. Even though the four models represented here agree about the effects of a doubling of CO₂ on average global surface temperatures, they disagree on regional changes in soil moisture. (The projections are for winter).

ing. Because of the complex relationships within the climate system, errors in calculating these processes can seriously compromise a model’s ability to simulate climate even on the largest scales.

It is because of doubts over whether the models are simulating the small-scale processes accurately that some scientists, such as Richard Lindzen of MIT, are skeptical of the predictions of global warming. Nevertheless, most scientists, myself among them, believe that the range of values climatologists usually quote—as in the Charney committee’s 3°F to 8°F—largely accounts for this uncertainty.

A major reason for the models’ shortcomings in calculating the effects of small-scale processes is the limited capacity of computers, which restricts the number of locations in the climate system whose state a general circulation model can describe. All climate models must make trade-offs between the number of locations they simulate, the number of climate processes they calculate, and the accuracy with which they calculate those processes.

Today’s highest-resolution climate GCMs specify the state of the atmosphere at the intersections of a three-dimensional grid. This grid is divided into sections that are approximately 250 miles on a side in the horizontal direction—an area the size of New England and New York combined—and about a mile thick in the vertical direction. Since these models incorporate five variables at each intersection of the grid (temperature; wind speed in the latitudinal, longitudinal, and vertical directions; and concentration of water vapor), they must predict

about 150,000 numbers to describe the state of the atmosphere at a given time.

To keep up with atmospheric changes, these 150,000 numbers have to be recalculated about eight times an hour. Thus, to determine the evolution of the atmosphere—just one part of the climate system—over one year with such a model requires some 20 to 40 hours of calculation on a supercomputer.

The effects of small-scale phenomena cannot be completely left out of GCMs, or the models could not come close to simulating the current climate, much less changes in climate. The makeshift solution the models employ is to “parameterize” such effects. In other words, they simulate the effects by simplified equations based in part on current climate conditions and in part on approximations deemed reasonable in particular circumstances. By design, these simplified equations can be solved far more efficiently than the exact equations, but at the cost of accuracy; indeed, the simplified equations are often quite crude.

What’s more, different models use different parameterizations, which lead to contradictory conclusions about the regional effects of global warming. It’s for that reason that GCMs, despite yielding similar predictions for how much global mean temperatures will increase, disagree sharply on the patterns and magnitude of changes in soil moisture. For example, two models—those of the National Center for Atmospheric Research and the Geophysical Fluid Dynamics Laboratory—predict that a doubling of CO₂ would make southern California winters drier, while the GISS and United Kingdom Meteorological Office models indicate that the region’s winters would become wetter (*see the diagram on pages 36–37*).

It would be nice if we could get by without parameterizations. Unfortunately, calculating small-scale processes accurately requires much higher resolution than computers will be able to deliver in the near future. For

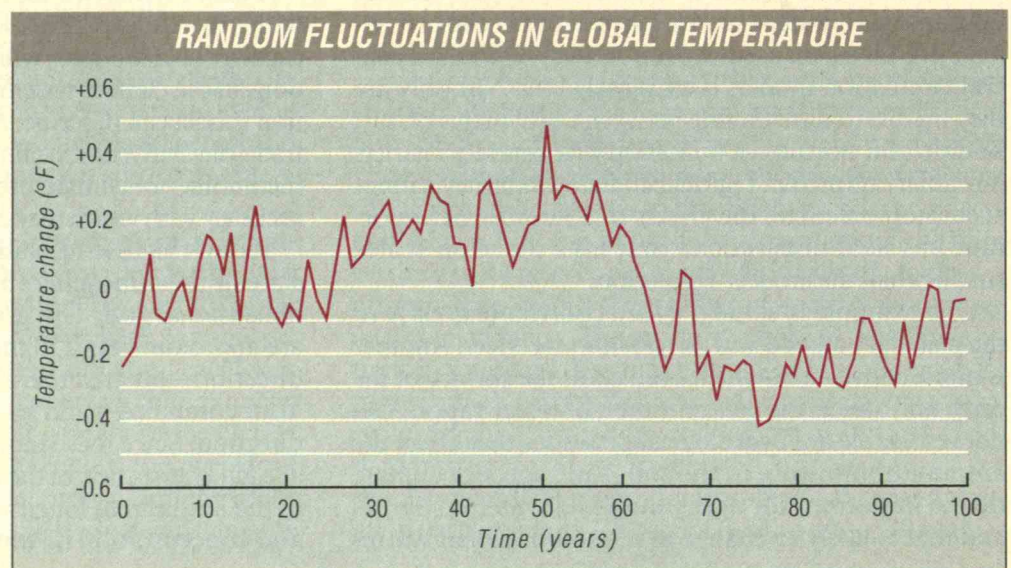
example, the important variations in moist convection occur on scales of 100 yards to half a mile. Resolving these processes would require a grid with a horizontal spacing 1,000 times smaller than today’s climate GCMs in both latitude and longitude. And to resolve the rapid evolution of the small-scale features of moist convection, the state of the atmosphere would have to be recalculated about 1,000 times more frequently. Some increase in vertical resolution would also be necessary. All in all, computers would have to be about 10 billion times faster than today’s to calculate moist convection accurately. So models must depend on parameterizations for a long time to come.

Even if our models could predict with certainty the ultimate effects of increases in trace gases, such as a doubling of carbon dioxide—and even if we knew precisely how fast the trace gases would increase—we would still need to know how quickly the climate would respond to the buildup. After all, people and ecosystems will adapt to climate change much more easily if it happens slowly.

The oceans play the biggest role in determining the rate of warming, because they are the component of the climate system with the greatest capacity to absorb heat. If warming seeps down only slowly into the ocean’s deeper layers, the surface layers—and hence the atmosphere—will heat up rapidly. Conversely, if the deeper layers absorb heat quickly from the surface layers, the atmosphere will take longer to warm up. Thus the 5°F warming predicted by the IPCC report might occur as early as 2040 or as late as 2200.

How fast the warming actually spreads to the deeper layers depends on the ocean’s circulations. But because of computer limitations, GCMs that try to calculate this process have inadequate resolution. These models do such a poor job of simulating today’s climate—sometimes misrepresenting sea surface temperatures by as much as 15°F—that we cannot have much confidence that they are simulating the physics of heat mixing correctly.

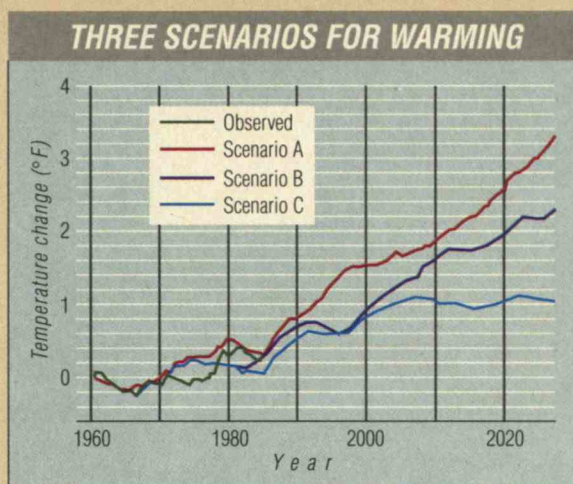
Because fluid motions in the climate system are chaotic, climate is in part unpredictable. Researchers at the Goddard Institute for Space Studies demonstrated this by running a 100-year climate simulation in which trace gases were frozen at 1958 levels. Even with no greenhouse warming, global temperatures fluctuated by nearly 1°F. Thus the 1°F warming noted over the last 100 years cannot be attributed unambiguously to greenhouse warming.



Sidestepping Uncertainty

IN the most sophisticated climate projections yet published, researchers at NASA's Goddard Institute for Space Studies (GISS), led by James Hansen, tried to sidestep some of the uncertainties that surround the timing of climate change. The rate of warming depends both on how rapidly the deep oceans will absorb surface heat and on how rapidly trace gases will build up in the atmosphere—neither of which is known.

Instead of attempting to calculate the ocean circulations, the GISS team assumed that heat mixes between the ocean's surface and deeper layers at the same rate that tri-



Rather than attempt to predict how fast trace gases will build up, GISS researchers devised three scenarios, each characterized by different rates of increase. Under Scenario B, which assumes the most plausible rates, global temperatures will have risen by more than 2°F by 2025 (0 represents the 1958 average temperature).

tium produced by atmospheric nuclear tests mixed into the deep oceans. Although the mixing of a passive tracer like tritium is not necessarily a good proxy for heat mixing, the GISS study, published in 1988, remains the only attempt to use a general circulation model to forecast how climate responds to realistic rates of increase in trace gases. Projections made in 1990 by the Intergovernmental Panel on Climate Change, for example, did not use a general circulation model but relied on a very simple model that represented global climate by a single temperature variable, the global mean surface temperature.

Continued on page 40

Removing Doubt

Models may never be able to reproduce all climate processes with absolute fidelity. However, they may not need to. It would be enough to construct a model incorporating only the processes that have a significant impact on climate and using good parameterizations of the processes that the model cannot resolve. Achieving this would require a better understanding of many of the physical and chemical processes involved. To this end, the bigger and faster computers likely to emerge over the next decade will let us carry out many more "sensitivity studies" to narrow down the processes that need to be included in the models. But the key ingredient necessary for improving our understanding—as well as for validating the models—is more comprehensive observations of the climate system.

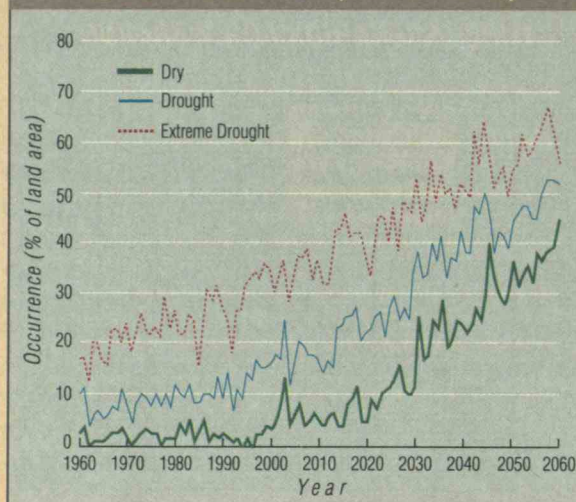
NASA's proposed Earth Observing System (EOS) could make a major contribution to gathering some of the necessary data. The agency's original proposal called for launching two series of polar-orbiting satellites packed with instruments to monitor many climate processes simultaneously. The first satellite would have been launched in 1998, and EOS orbiters would have continued making observations for 15 years, enough time to monitor long-term changes. Major goals

included expanding our knowledge of small-scale hydrological processes and the biological processes that affect CO₂ concentrations. Meeting these goals would improve our ability to predict changes in regional climate and bolster our confidence in predictions of global warming. Because of recent congressional budget cuts, however, EOS will have to be scaled down.

Addressing another big limitation of climate models—their rudimentary treatment of ocean dynamics—will require bigger and faster computers. William Holland and Frank Bryan at the National Center for Atmospheric Research in Boulder, Colo., have already carried out preliminary experiments with high-resolution ocean models that can accurately characterize important large-scale processes. Computers that are about 10,000 times as powerful as today's machines would enable us to include one of these ocean models in a global climate model. With the necessary resources, massive parallel processing machines could allow this soon, perhaps in three or four years.

But the ocean models, too, will still have to be validated against observations. Without good ocean models, our ability to predict regional climate changes and the rate of global warming will be severely limited. A project that could provide the necessary data is the World Ocean Circulation Experiment, a multinational

OCCURRENCE OF DROUGHTS OVER LAND AREA (SCENARIO A)



If greenhouse gas emissions continue growing at the same rate as in recent years (GISS Scenario A), the area of the world stricken by droughts during June, July, and August could increase dramatically.

To avoid the problem of predicting how quickly trace gas concentrations will increase, the GISS researchers posited three different scenarios. Scenario A assumes that concentrations of trace greenhouse gases will continue to grow by the same percentage per year as in recent years. This scenario is similar to the IPCC "business-as-usual" scenario. Scenario C assumes that trace gas concentrations will not increase after the year 2000. This is a rather extreme scenario, requiring that CO₂ emissions be cut by more than 50 percent. Scenario B is an intermediate scenario that assumes concentrations will continue to increase, but in a slower, linear fashion rather than exponentially as in Scenario A. This is perhaps the most plausible of the three

scenarios. According to Scenario B, by the year 2025 the global mean surface temperature will have risen 2°F above the average level of 1958.

The rise in temperature predicted by Scenario B would be comparable to historical changes that have had major socioeconomic impacts. For example, a change

of 2°F is about the same as the temperature decreases and increases associated with the onset and disappearance of the Little Ice Age, which lasted from about 1400 to 1850. Historical records show that these temperature variations caused significant changes in the severity of European winters, major advances and retreats of alpine glaciers and North Atlantic pack ice, and wide-scale abandonment of many formerly productive agricultural areas.

Despite their sophistication, however, the Goddard Institute projections are still subject to many of the same uncertainties as other models, such as possible errors in simulating small-scale processes and oceanic heat transports.

—Peter H. Stone

project started in 1985. Plans call for mapping ocean circulations by taking measurements from ships, moored arrays, and subsurface floats over a period of 10 or more years. Unfortunately, funding constraints have already brought about so many cuts in the original program that WOCE may not yield enough data for testing ocean models adequately.

In view of the funding difficulties of large projects like EOS and WOCE, scientists are scurrying to come up with less costly ways of gathering the most crucial information for improving climate predictions. One project that holds great promise is an experiment devised by Walter Munk of the Scripps Institution of Oceanography in La Jolla, Calif., and Andrew Forbes of the Commonwealth Scientific and Industrial Research Organization in Australia.

The two researchers propose placing acoustic sources deep in the oceans at different locations around the world and then listening to the signals at a distance with hydrophones. Since the speed of sound in the ocean depends on the temperature of the water, measurements of the time delay between generating and receiving the

acoustic signals will reveal the mean temperature along the path traveled by the sound waves. By measuring the temperature along many paths, it would be possible to determine how rapidly the deep oceans are warming and thereby improve predictions of how rapidly global temperatures will rise.

The project, scheduled to start in 1993, has received initial funding from a U.S. interagency group, and its feasibility has already been tested. If all goes well, accurate measurements of ocean warming will be available sometime in the first decade of the next century.

Although research efforts like Munk and Forbes's could lead to more reliable climate predictions within 15 or 20 years, some of the more extreme projections raise the possibility that global warming will outrun our ability to forecast it accurately. But even if that happened, we would still have compelling reasons to continue working on the climate modeling problem. Global warming, if it does occur, is unlikely to be the last environmental change we bring upon ourselves. So if we are ever to learn to foresee the consequences of our actions, we must improve our understanding of climate and our ability to model it. ■

MIT

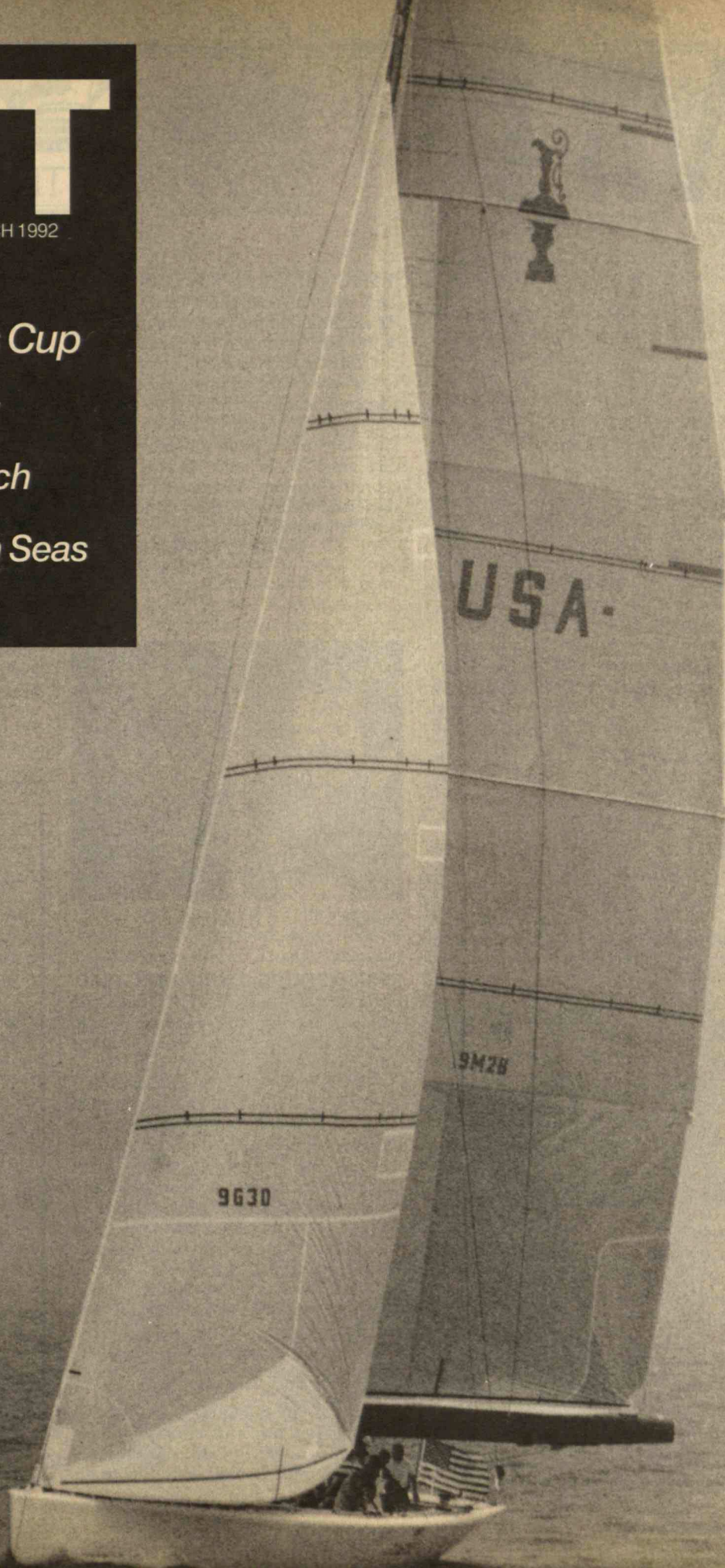
FEBRUARY/MARCH 1992

America's Cup

1992:

High Tech

On the High Seas



UNDER THE DOMES

Ig Nobel Prizes

3

AMERICA'S CUP 1992

Bill Koch's Quest for the Auld Mug

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COVER

Years of effort will culminate in a series of trials this spring to determine if America³, a syndicate headed by Bill Koch, '62, or Dennis Conner's team will defend the America's Cup, the greatest prize in sailing. On the water day after day under sails emblazoned with the Cup, Koch has set out to prove that technology and determination can beat experience. See article on page MIT 4. Photo by Donna Coveney.



LETTERS

IF YOU AREN'T AN MIT GRAD, YOU CAN ALWAYS MARRY ONE . . .

Please note that the person on the cover of the MIT section in the October issue of *Technology Review* did not attend MIT, as the cover caption implies, but rather attended Stanford University. He happens to be my husband, Erik Engebret. Therefore, the caption should read "The Classes of '76, '81, and '86, and Erik Engebret (Stanford '85) pooled their party spirit and held a reunion dance at the Science Museum. . . ."

MARY C. ENGBRETH, '86
Class Secretary



Fassett



Elliott

REMEMBERING TWO WHO CARED

I received the August/September issue here in Germany, and was saddened to find obituaries of two of the people I respected most at Tech.

When I arrived in September 1960, I was placed in Burton House for rush week. Early in the week I went to the Activities Midway and hooked up with the Tech Model Railroad Club. I went over to their layout in Building 20 and ended up staying for more than 24 hours. When I returned to Burton, there was a note for me to call Dean Frederick Fassett—day or night. It was after 11 pm, and I had no idea why he wanted to talk to me, but I called him. He was simply worried about my whereabouts—someone had noted my unexplained absence, and he had heard about it.

Professor John Elliott, ScD '49, was my best teacher and closest faculty friend in Course III. He was the only faculty member to ever invite me to his

home (for Thanksgiving dinner 1962), and his introductory thermodynamics course was the only core subject in which I ever earned an "A" at Tech. He ended up being my thesis advisor as well. Although I never worked in the field of metallurgy, I've used the things he taught me in many other ways over my 27-year Army career.

COLONEL JOSEPH E. BOLING, '64
United States Army

CORRECTION:

In the October article on Reunions '91, (page MIT 15) we erroneously stated that the Class of 1976 contributed the second largest 15th-reunion gift ever recorded. Actually, it was the *largest* 15th-reunion gift thus far, and the members of the Class of '76 are deservedly proud of their efforts.

GAZETTE

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An Ig Nobel Evening

The MIT Museum was packed tighter than leafers on the Mohawk Trail on the night of last fall's Ig Nobel Prize Ceremony, cosponsored by the Museum and the Journal of Irreproducible Results. Fittingly, the awards were to honor "irreproducible achievements in science and the humanities."

"Ig Nobel Authority Figures" directed guests: "Walk straight ahead," they said helpfully, "then turn left at the cow." I joined the "Dignitaries"—many in disguises to dispel any shred of rationality—in the front of the room, and we watched participants parade by with assorted placards: "Recovering Mathematician," "Questionable Character," "Point of Light," "Second Point of Light," "Down with Up," "Up with Down," "Seeking a Lift to New York," and "We've Fallen Down and Can't Get Up."

Journal Editor Marc Abrahams took the stage. Abrahams quoted the late Ignatius ("Ig") Nobel, by way of explaining that "an irreproducible achievement is an achievement that can't be reproduced... or shouldn't be." Formalities thus dispensed with, Umpire John Barrett shouted, "Play Ball," and the festivities got into full swing.

First the "salient dignitaries" were introduced, including the Swedish Meatball King and Queen and the attending Nobel Laureates—Henry Kendall, PhD '55, recipient of the 1990 prize for physics; Eric Chivian, MIT physician and recipient of the 1985 prize for peace; and Harvard Professors Sheldon Glashow (1979 prize for physics) and Dudley Hershbach (1986 prize for chemistry). The taped remarks of MIT Professor Jerome Friedman, who shared the 1990 physics prize with Kendall, kept the crowd roaring with laughter.

David Vlach of the Cambridge Chamber of Commerce unveiled the grand prizes for Ig Nobel winners: "A key to the city, which, unfortunately, doesn't open anything," and a parking pass good on December 26, from 3 to 4 a.m. The anticipation was so thick you could cut it with a slide rule.

Keynote speaker was MIT Associate Provost Jay Keyser, who holds the de Florez Chair, making him, ex officio, the Institute's Chief Officer for Humor. Thus ensued a recitation of all the bad jokes that had been inflicted on Keyser since he took office. Needless to say, Peter de Florez, '38, whose nearly \$3 million bequest in support of humor at MIT partially funded the Ig Nobel Prizes, was in no position to ask for a refund.

Finally, Abrahams got to the evening's main event by announcing the winner of the 1991 Ig Nobel for Physics: Thomas Kyle. Kyle was honored for his discovery of the heaviest element in the universe, Administratium, which consists of one neutron, 75 associate neutrons, 125 deputy associate neutrons, and 11 assistant deputy neutrons. The Ig Nobel Prize in Pedestrian Technology went to Paul Defanti's Buckybonnet, a "geodesic fashion structure that pedestrians wear to protect their heads."

Dan Quayle captured the Ig Nobel Education Prize. An 8-year-old girl claiming to be Mr. Quayle accepted the prize, saying, "As chairman of the National Space Council, I sorely regret my lack of technical knowledge. I look forward to learning the calculus."

Edward Teller, father of the hydrogen bomb, won the Ig Nobel Peace Prize for his "lifelong efforts to change the mean-

ing of peace as we know it." Michael Milken, "father of the junk bond, to whom the world is indebted," won Ig Nobel honors in economics. Milken was unable to attend the ceremony, however, owing to a previous 15-to-20-year engagement.

And the Ig Nobel Prize in Medicine went to Alan Kligerman, inventor of the anti-gas digestive aid, Beano. The product, Kligerman modestly explained, offers "an end to those dreadful moments when people don't know whether to look at the dog or each other."

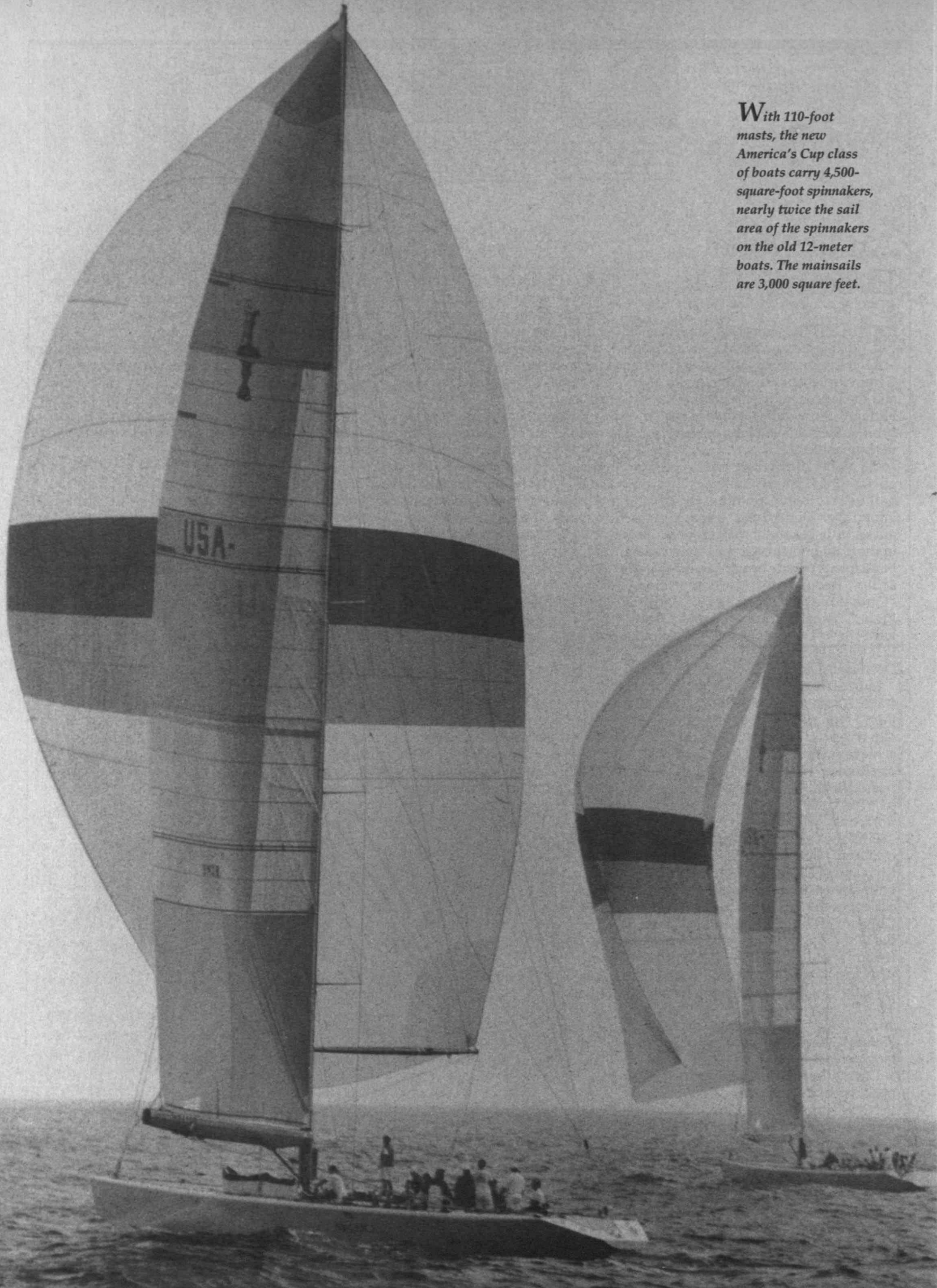
In all, 10 prizes were awarded in 1991, but the Ig Nobel committee assured me that, next year, the ceremony will be even bigger... broadcast live, worldwide, on all six or seven or however many continents there are. "I want people to use the same words to describe this event," said Abrahams, "that Mencken used to describe the Pulitzer Prize: 'Imbecilities repeated annually.'"

"That's fine," I said. "Just make sure those imbecilities are repeated, not reproduced."—Steve Nadis □

Paul Defanti, right, demonstrates his geodesic BuckyBonnet for fellow revelers at the MIT Museum. The invention won him the 1991 Ig Nobel Prize for Pedestrian Technology.



With 110-foot masts, the new America's Cup class of boats carry 4,500-square-foot spinnakers, nearly twice the sail area of the spinnakers on the old 12-meter boats. The mainsails are 3,000 square feet.



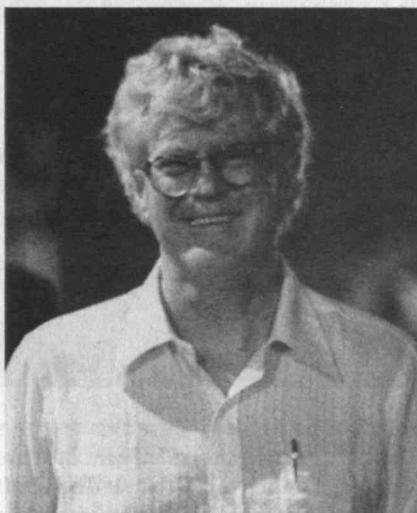
MIT's Captain Outrageous

By Mark Fischetti

Bill Koch has a singular agenda. He intends to win the America's Cup, the Indy 500 of yacht racing. In everyone's mind but his own, Bill is a long shot. He has relatively little experience sailing. He has no commercial backers. And he has taken a completely different approach to designing his boat. There's no way he can win, seasoned sailors tell him. His reply? "Wait and see... just wait and see."

It was with a restrained and determined tone that Bill Koch uttered those words to *Technology Review* in December. Indeed, he admitted, the best way to get his ire up is to tell him he can't do something. Throughout his life, his motivation has often sprung from defiance. When he was growing up in Wichita, Kansas, in the 1950s, he says his family told him he wasn't smart enough to get into Culver Military Academy. He did. Then Culver told him he wasn't smart enough to get into MIT. Not only did he get in, he went the whole route, SB to ScD in chemical engineering. Since that time he has helped run his family's multibillion-dollar company, started several enterprises of his own, and contradicted the conventional wisdom of the sailing world.

Bill Koch (pronounced "coke") first gained notoriety in 1983, when he sued two of his brothers, David ('62) and Charles ('57) over their management of the family firm, Koch Industries, an oil and coal conglomerate. The bitter court battle was played out on the front page of the *Wall Street Journal*. But it has been his recent quest to win the America's Cup, accompanied by an open war of words with his detractors, that has buoyed him to international celebrity. The Cup, and Bill's reputation, will be decided in a



Bill Koch, '62

week of racing in San Diego Harbor in May.

William Ingraham Koch, '62, has always been driven by an uncompromising desire to win, to prove he can be the best, to defy those who defy him. Young Bill experienced all these emotions at an early age, often battling with his three equally antagonistic brothers. As a role model, their father, Frederick ('22), only provoked their competitive spirit. Stubborn and imposing, the senior Koch was a strict disciplinarian. He made his fortune building refineries in the Soviet Union before World War II, and building Koch Industries, now estimated to be worth \$16 billion, the second-largest privately held firm in the United States.

Bill majored in chemical engineering at MIT because his father had done the same. As far as Fred was concerned, MIT was the only place for his sons to go; it was the best school in the world for preparing young men for the oil business. Soon Bill found he liked chemical engineering and had an aptitude for it. He

earned an SB in 1962 and then continued on to the doctoral level.

"He wanted to show he could go as far in chemical engineering as anyone could go, and he wanted a doctoral degree because neither his brothers nor his father had earned one," says Raymond Baddour, ScD '51, Lamont du Pont Professor of Chemical Engineering Emeritus. Baddour had seen Bill, his older brother Charles, and his twin brother David through their MIT years, and was Bill's thesis advisor.

It was Baddour who taught Bill the first of several lessons he would take from MIT. Baddour challenged Bill, as he did the rest of his students, with the Socratic technique of badgering them with questions to see how much they really understood. "It got him angry and red-faced," Baddour says. "One time I think he wanted to work me over in the hall after class." But Bill has since come to appreciate the value of being challenged. "MIT's approach, in particular Baddour's courses," he says, "taught me how to think logically from fundamental principles."

Bill also competed with brother David for a starting position on MIT's basketball team, but lost. "I sat on the bench and he played, which wasn't much fun," Bill says. But just being on the team put the tall and lanky Bill in a position to learn from the second of his MIT mentors, basketball coach Jack Barry. MIT's team was pitiful the first two years Bill played. Barry was brought in. "Jack reorganized the team and gave us only one play," Bill recalls. "He drilled us over and over again. In my junior year we won half our games. In my senior year we had the longest winning streak and the least points scored against us of any team in the nation. Jack did it by stressing teamwork, and by instilling in everybody the attitude that MIT would win."

Mark Fischetti is a technology and business writer based in Lenox, Mass.



The second of Bill Koch's three Cup yachts, *Defiant* (above), was built in Bristol, R.I. Below (from left): MIT research specialist Noah Eckhouse, Jerome Milgram, '61, the William I. Koch Professor of Ocean Engineering, and grad student Donald Peters work on a velocity prediction program for the sailing dynamometer.

Bill, now 51, considers this lesson so important that he thinks MIT should stress teamwork much more than it does. "MIT concentrates on individual performance. The Japanese concentrate on the performance of a unit. You need both. I only learned teamwork at MIT because of basketball. I didn't learn it in the classroom."

An Entrepreneurial Craving

After leaving MIT, Bill joined the family firm, rising to vice-president by 1979. But sibling rivalries erupted. When David and Charles, the chairman, tried to limit Bill's power, Bill and his eldest brother, Frederick, mounted a proxy fight to take over. They lost, narrowly. Charles fired Bill. Bill and Frederick sold their stakes for a reported \$800 million.

Bill was rich but not happy. He took his brothers to court, claiming they had undervalued his shares. The fighting got worse. A federal judge finally dismissed the charges, but allowed Bill to continue to pursue allegations that his brothers had cheated him. "When you go into battle, the only way to do it is to assume you are going to fight to the finish," Bill told the *Wall Street Journal* at the height of the war. Charles confirmed his brother's duel-to-the-death mentality: "I fully expect the

feud to continue as long as Bill has breath or money."

Despite the suits, the family fortune left Bill secure enough to follow his entrepreneurial craving. He started Koch Venture Capital, which financed high-technology start-up companies. He founded Koch Carbon Inc., a trader in petroleum, coke, and coal. He began the energy trading company, Oxbow Corp., which he ran from Boston until 1988, when he moved his company, his wife Joan, and his now 4-year-old son Wyatt to Palm Beach, Fla. He hung onto his ties to the Northeast, however. He has a summer residence in Osterville, Mass., on the shore of Nantucket Sound, is a major contributor to MIT, and is a trustee of Boston's Museum of Fine Arts and the city's University Hospital.

Like Bill, Oxbow, the company he still runs, is unconventional. Its diverse holdings include a geothermal power plant in Nevada, a wood-fueled plant in Maine, and an offshore oil field west of California. Last year sales reached \$500 million. *Forbes* magazine's list of richest men puts Bill's worth at \$650 million.

Yet the former engineering major misses the science. "I'm a little disappointed that I've followed a different path," he says. "I liked chemical engineering, and it would have been fun to use it." Bill has managed, however, to combine his interest in chemistry with his financial acumen, thanks to his old professor. Baddour has started or helped start 15 companies since the early 1960s, most of them chemical or biotechnology concerns. Bill has invested in several of them, helping Baddour make his own small fortune.

Bill's entry into boating resulted from his penchant for eclectic acquisitions. He has a notable art collection, a 25,000-bottle wine cellar, and six cannons. In 1984 he purchased an 80-foot, secondhand yacht and decided to race it. He stripped the boat of its trappings, renamed it *Matador*, and painted a logo on its bow appropriate to its owner's character—a bull's head. In international sailboat racing, yachts compete in categories delineated by size, as boxing categories are by weight. *Matador* fit the "maxi" class, the biggest boats. In the Maxi World Championships, Bill came in second three years running.

It frustrated him no end. There is no second place in Bill Koch's lexicon. He wanted to win. So he decided to design the fastest maxi possible. But when he badgered designers from around the world

with questions, he was frustrated further. "I kept asking them 'What makes a boat go fast?' and their answers didn't make any sense. They saw themselves as artists. They had no scientific basis for their designs."

Technology Yields a Better Yacht

That's when Bill returned to MIT and the scientific method. He teamed up with Jerry Milgram, '61. Since the 1960s, Milgram has been a professor in the Department of Ocean Engineering, which is world renowned; almost every U.S. military boat has been designed by graduates of the department. Bill sponsored a design competition that drew scale models from 20 naval architects, and Milgram analyzed them in special test tanks he had developed. "Then I told Bill that I could evaluate what made a boat go fast," Milgram says, "and that knowledge could be used for design optimization." Among other things, Milgram built a sailing dynamometer—a special sailing vessel about 40 percent of the size of a maxiboat. While sailing, the dynamometer's transducers measure data for mathematical models that can be used to predict the performance of sail configurations.

The new maxiboat that evolved as a result of these evaluations, *Matador*², "was contrary to what everybody thought a boat should be," Bill says. "Everybody thought a fast boat should be short and light. We went long and heavy." Science proved to be a winning player. *Matador*² could carry a greater ratio of sail area to the area of hull surface in the water. By analogy, Bill had a stronger engine propelling a car with lower air resistance. *Matador*² won the world championship in both 1990 and 1991.

After the 1990 win, word got out that Bill had gone to MIT to elevate the state of the art of racing boat design, and every potential America's Cup defender approached him seeking his technology... and his money. "We without a doubt had more knowledge about racing-yacht technology than anybody else," Milgram says.

Suddenly, the landlubber saw an opportunity to upstage the yachting crowd. Why, Bill asked himself, should someone else benefit from his work? He also saw "a chance to apply technology to a sport that everyone thought was best handled by the seat of the pants," he says.

Bill and his team started development of the new America's Cup yachts. New



rules governing the construction of boats for the International America's Cup Class for the first time allowed boat hulls to be made with carbon fiber, an advanced composite material. The new boats would be spectacular. They would be 75 feet long with masts rising 110 feet from the deck. They would carry 8,000 square feet of sail. Thanks to the extremely light but strong carbon fiber they would weigh only 50,000 pounds, almost a third less than earlier racers of a similar size. Yet 80 percent of the weight would rest in the keel far below the waterline, so the boats could sway side to side atop the ocean's wavy surface like unsinkable pendulums.

Thus Bill's design team has developed new hull shapes, and has experimented with different hull structures, looking to reduce weight but add strength so the boat can withstand the stress of a greater sail area. For expertise in building with carbon fiber, he teamed up with Hercules Aerospace, which makes advanced missiles and airplanes for the Defense Department. But because the Cup is so competitive, no one in any of the syndicates—Koch's or his competitors—will divulge further details.

Sailing syndicates from nine countries have since entered what looks like a yachting arms race. New Zealand has a budget of \$40 million, Japan \$60 million, Italy \$120



Bill Koch's syndicate, America³, built its first boat, Jayhawk (above), at Hercules Aerospace in Utah to capitalize on the company's experience working with carbon fiber. Below: A³ crew members sort some of the 18-25 sails needed for each boat.



million. Beginning in January 1992, all of these syndicates will vie in qualifying races for a single spot as challenger. In May, the challenger will then take on one defender, the winner of an American run-off. There will be only two U.S. contestants: Bill Koch and his nautical arch-rival Dennis Conner, four-time winner and current holder of the Cup.

"Because of what is at stake," Bill says, "the America's Cup is no longer the friendly competition between nations that it used to be. It is warfare." The Cup Match has lost the golden haze of a "gentlemen's" sport. The huge investments involved have brought with them the inevitable espionage—several syndicates have caught divers trying to take underwater photos of boat hulls and keels—and tight security measures. Bill's boat-building operation in Bristol, R.I., is hidden away in a nondescript industrial building with sheet-metal walls, no windows, and guards at the doors.

Once again, Bill Koch has rushed into battle. Winning the Cup is shaping up to be his ultimate challenge. Every motivation that ever stirred him has presented itself. There is the personal competition

with Dennis Conner, who waved the red cape by stating that there is no way Bill, with so little experience, could out-sail him. And the other syndicates have said there is no way Bill could out-invent them. Capturing the Cup is also a chance for Bill to push all his talents to the limit: technological smarts, organizational skills, team building, and the ability to apply science to a nonscientific endeavor. "I wanted to bring it all together."

A \$40-Million High

The ego trip will cost \$40 million. Bill has pledged \$25 million of his own money, and the rest is coming from private donations. He will carry no advertising on his boats, unlike the other syndicates. He thinks it is hypocritical for a syndicate that is supposed to represent an entire country to carry sponsors' logos on their sails and hulls. "The other boats will look really tacky," he told the crowd at a November fundraiser in Boston.

Bill already has two boats in the water, with one more on the way. The first is named *Jayhawk*, in honor of his Kansas roots. The name of the second boat is clas-

sic Koch: the *Defiant*. Two of his three boats will compete against Dennis Conner's team in the defender trials.

Of particular curiosity to the sailing world is Bill's insistence on being the helmsman of his lead boat, a spot reserved for veteran yachtsmen. The other syndicates are saying he will be his own team's worst liability. In contrast, they've secured the world's best helmsmen, without regard for nationality or price. New Zealand has lured away an American gold medalist sailor to pilot its ship. Japan has signed a leading New Zealander. Italy has also hired one of the best U.S. skippers, for a reported \$1.6 million.

Bill has a standard reply to the criticism: It's his boat; he wants to drive it. His determination to go against the grain harks back to the only two other amateur sailors ever to captain their own Cup entries: Ted Turner and Harold Vanderbilt. And Bill's tendency toward extremism, his taste for odd collectibles, and his tumultuous family business background conjure up the image of another notable boater, Malcolm Forbes.

With perhaps more humility than these men, however, Bill also defines his



***Amphitrite**, the sailing dynamometer developed by Jerry Milgram to measure sail forces, is 42 percent of the size of the racing yachts. The test boat is sailed by two members of the America³ team (from left), Eric Steadman and Bruce Sutphen.*

quest as a patriotic one. Though his crew of 40 (16 for each boat plus eight backups) does boast two Olympic medalists and five world champions, it also comprises people from 34 states, age 19 to 61. Two have never sailed before. He is living out Coach Jack Barry's philosophy: Ordinary people can accomplish extraordinary things. "You can even do it with MIT grads," Bill wisecracks. He is sick of hearing how overseas companies and overseas individuals are better than those in the U.S. "To me this is a chance to show that American technology, American management, and Americans with the right attitude and team purpose can compete with the rest of the world and *win*."

Bill is not merely engaged in a war of words, however. His syndicate, America³, has drawn on top technologists from around the country. The board of America³ is led by Louis Cabot, chairman of the Brookings Institution and a life member of the MIT Corporation. Robert Seamans, ScD '51, former dean of engineering at MIT, is also on the board. The design team includes experts from Lawrence Livermore Laboratory, Stanford University, and the University of Maryland. Bill

has built a two-acre compound on the San Diego wharf, complete with sail and machine shops.

Nor is it merely a battle of "our technology" vs. "their technology." Each race of the trials and the Cup Match will consist of eight legs and last three or four hours. Each crew member will confront great physical demands. Bill spends six days a week on San Diego Harbor drilling his team, especially himself. The compound has a gym and a rehab center staffed with four physical therapists. Bill says he is in the best condition he's been in since his MIT basketball days. He is also pushing his design staff to constantly refine the boats. "It's a phenomenal effort," says Milgram. "We're all suffering burnout."

Bill is probably under the most pressure—his own. He credits his MIT experience with helping him stay the course. "I learned teamwork and how to think at MIT," he says. "I also learned perseverance." As for motivation, he has no problem sustaining it. "Lots of people tell me everyday that I can't win the Cup."

Will winning finally satiate Bill's need to excel? "If he wins it will have a major impact on his personality," says Bad-

dour, who has worked with him for 30 years now. "There is a certain insecurity he has always had. Winning the Cup will wipe that out."

Bill says he doesn't place that much weight on the upcoming battle. "I've given up competing with my brothers," he says, though his lawsuit against them is still open. "When I was younger, I'm sure I was looking for their approval or respect. But I've learned that when I do my own thing, I do much better. Winning the Cup won't be my salvation, and losing won't be my downfall. Winning will just give me great satisfaction, verification that our scientific approach to design and our sense of team commitment work."

Nonetheless, it's impossible to think of the maverick yachtsman as anything but inexorably driven. And perhaps even he, too, is a bit burned out. When asked what war he will wage next if he wins the America's Cup, he says "I don't know. Right now I can't think about anything else. . . . Someone once asked Harry Truman what he was going to do when he got home after the presidency. He said, 'Well, I'm going to go upstairs and unpack my bags.'"



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I am sure any classmate reading these notes will remember **John A. (Al) Lunn** and his wife Sue (Williams). I recall working for and with Al when he was president of the Alumni/ae Association, member of the MIT Corporation, and chair of the association's Long Range Planning Committee, whose impressive report changed the course and scope of the association and propelled *Technology Review* into an international magazine whose non-alumni paid circulation is about 55,000. But why mention this now?

Recently, Phyl (Severance) and I were browsing in the Wellesley Library. In Joan Peyser's biography of Leonard Bernstein the following caught Phyl's eye. As a youngster, Bernstein learned from a neighbor's daughter to play some beginning pieces on the piano. "At 12 Leonard moved on to the New England Conservatory of Music, where he was assigned to Susan Williams, who charged \$3 an hour."

At reunions we had heard that Sue was Leonard Bernstein's first piano teacher—and therefore, first music teacher. Now, here it is for the world to read!

If you have no current news about yourselves, how about sending me any tidbits like this to share with your classmates.—**Don Severance**, acting secretary, 39 Hampshire Rd., Wellesley, MA 02181

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Please send news for this column to: **Max Seltzer**, secretary, North Hill, Apt. B403, 865 Central Ave., Needham, MA 02192

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We recently received a letter from the MIT Alumni/ae Fund concerning Project 2000 which has the goal of providing the funds to upgrade or renovate the core teaching facilities that were erected 75 years ago on the banks of the Charles River in Cambridge. We have a special interest in this project because before classes could start in those new buildings of our time, materials and supplies had to be trucked from Boylston Street in Boston to Cambridge. Your class secretary with Mr. Elsworth Patterson and others from MIT classes worked all summer to distribute the materials to the locations in the buildings where they would be used when classes got started in the early fall. It was a memorable summer conveying materials to their new locations as we passed through the new corridors singing MIT songs. So when you may get such a letter from the Alumni/ae Association, please do your best. Thank you.

Today I spoke with **Donald D. Way** our class president and we agreed to draw \$500 from our class savings account and donate it in the name of our class of 1919 to Project 2000. I found Don in good shape as well as his wife Barbara.

Francis Weiskittel has always been interested in our class, and I had an enjoyable talk with him on the phone today. Don Way had a pleasant meeting in his Baltimore home some time ago. Francis wrenched his left knee while using the banister on a stairs, which causes him discomfort.

I called another classmate **Doc Flynn** in Leighton, Pa., but he was out. He is another classmate with whom it is pleasant to converse.

As fall advances and winter sets in, keep warm. Wishing you all the best, I remain, yours sincerely—**Bill Langille**, secretary, Box 144, Gladstone, NJ 07934, (908) 234-0690

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A welcome letter from **Allen Arkett** tells of **George des Marais** moving from Norton, Ohio, to Pebble Creek Center, 670 Jarvis Rd., Akron, OH 44319, where he is in close touch with his son, granddaughters and great-grandchildren.

Bill Dewey died last March. He was a professional engineer for more than 45 years. He leaves his wife, Barbara, two sons, a daughter, nine grandchildren, and ten great-grandchildren. He was VP of Anderson-Nichols & Co. of Boston.—**Harold Bugbee**, secretary, Apt. 313, Country Club Heights, 3 Rehabilitation Way, Woburn, MA 01801

21

Not much news this month. In a telephone call to Claudia (Mrs. **Josiah**) **Crosby** I learned she had sold her summer house in Brookline, Me., and plans to spend Christmas with a relative in Alabama. She still drives her car but only around Sarasota.

Herbert Kaufmann lives in a retirement home a short distance from Claudia but Claudia said she had not seen him in a long time. The same is true with Alice (Mrs. **Robert**) **Felsenthal** who lives alone on Siesta Key in Sarasota, Fla.—**Sumner Hayward**, secretary, Wellspring House E64, Washington Ave., Ext., Albany, NY 12203; **Samuel E. Lunden**, assistant secretary, 6205 Via Colinita, Rancho Palos Verdes, CA 90274

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70th Reunion

For those planning to come to Cambridge for our 70th Reunion June 4-5, a summary of plans and events will be mailed to you by the Alumni/ae Association. After registration in McCormick on Thursday, we are invited by the Cardinal and Gray Society to a reception in the late afternoon.

Sorry to have to report the deaths of two classmates. Rear Admiral **Charles A. Nicolson II** died in Winter Park, Fla., last July 21 at age 97. He graduated from Annapolis in 1918 and came to Tech for the SM. He had a long and distinguished career in the Navy, becoming a rear admiral in 1943. His final duty was as assistant chief of the Bureau of Aeronautics for Engineering and Design in Washington, D.C. He spent his retirement years in Florida. He is survived by a son, Charles III, two brothers, a sister, and several nieces and nephews.

Robert Prescott died August 1, 1991, in Kinnelon, N.J., at age 91. At Tech he was a member of Phi Sigma Kappa and was a broad jumper on the track team. A native of Passaic, N.J., he worked for 50 years for the J.L. Prescott Co., becoming chairman of the board before retiring in 1973. He is survived by two daughters, Molly Kindred of Scarsdale, N.Y., and Nancy Ward of Kinnelon, five grandchildren, and a great-granddaughter.

We extend our condolences to the families of these classmates.

Try to make it in June—don't put it off until our 75th.—**Yardley Chittick**, secretary, Rt. 1, Box 390, Ossipee, NH 03864

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An obituary of **Horatio L. Bond** (Bondie), one of our most popular classmates, appeared in the November/December issue, crediting his many capacities of service to MIT. Here we wish to include some of his other activities. He received an SB in business and administration. As an undergraduate he was interested in many activities: Tug-O-War team, Track, Rifle Club, Corporation XV, *The Tech*, and editor-in-chief of *Benchmark*, to name a few. He married Dorothy Gere and worked for the National Fire Protection Association for 45 years, retiring as chief engineer. He was an authority on fire protection, fire codes, and standards, and served on many boards and commissions on fire protection. He was an ROTC officer during World War II in civilian service, and his professional memberships were numerous including many awards. The sympathy of our class is extended to his family.—**Frederick O.A. Almquist**, secretary/treasurer, 63 Wells Farm Dr., Wethersfield, CT 06109

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From the Alumni/ae Association I have received notices of two more deaths in the class. One was **Clarence Edwin Miller**, 90, who died in his home in Hampton, Va., on July 18, 1991. Clarence retired from Dupont Chemical Co. in 1965. He was a member of the American Society of Chemical Engineers and a graduate of Washington and Jefferson College in Washington, Pa. He went on to receive a master's degree from MIT. He is survived by his wife, Laura, four sons, 15 grandchildren, and seven great-grandchildren. Our sympathy goes out to all the family.

Also, Rear Admiral **Paul E. Pihl** died July 18, 1991, at age 93. Did you know that Pihl's life and experiences were the model used by novelist Herman Wouk to create the character Pug Henry in his best-seller, *Winds of War*?

Pihl's life story reads like a novel. He was a graduate of the U.S. Naval Academy where he earned a master's degree in engineering. Before World War II, as a U.S. Naval air attaché based in Berlin, Germany, he was toasted and presented a medal by no less than Gen. Hermann Goering, for his promotion to commander. Later, representing the United States at a function in Moscow, Pihl was notified of another promotion—to Navy Captain—while at the banquet at the Kremlin. There he was toasted by Josef Stalin.

Pihl was married twice, the first time to the sister of Wendell Willkie, the unsuccessful Republican presidential candidate against Roosevelt in 1940. In 1942, Pihl and Willkie went on a seven-week, worldwide mission to unite allies in the war. As an admiral, Pihl had a distinguished war record. He outlived his second wife, Dorothy.

I also received a letter from **Dick Shea**. In his letter he tells of the death of **Edward Abdun-Nur**

during the week of October 1. Edward is listed as a consulting engineer in the class records who lived in Colorado. Dick reminded Col. Stern and myself that soon a chairman for the 1994 reunion should be picked. We need someone to select a place to stay, arrange for attendance at the MIT reunion and MIT Day at the Pops, etc. Do I hear any volunteers?—Co-secretaries: **Katty Hereford**, Box 5297, Carmel, CA 93921; Col. **I. Henry Stern**, 2840 S. Ocean, #514, Palm Beach, FL 33480

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The class list provided annually by the Alumni/ae Association allows the secretary to bring his files up to date. As of September 30, 1991, we had addresses for 124 classmates. Few changes in my file were necessary. . . . **Leslie Bragg** moved from Summit, N.J., to Skaneateles, N.Y. . . . **Leroy Davis**, who was living in Doylestown, Pa., moved to Tefton, Pa. . . . **Hyman Katz** moved from Edgartown, Mass., to North Quincy, Mass.

The list includes the names of 79 persons considered members of the class, although most have not been heard from in many years. Of these, 50 received degrees with the class and 29 left before senior year. Information regarding those who received degrees in 1925 would be much appreciated. Four names selected at random and their locations when last heard from are: **Fred Grantham**, Hollywood, Calif.; **Howard Nelson**, Boligee, Ala.; **John J. O'Brien**, Providence, R.I.; and **Robert Quinn**, Louisville, Ky. If anyone has information regarding these classmates, please let me know.

George H. Fuller died in Colonia, N.J., May 30, 1991. George worked for Colgate-Palmolive Co. for many years and upon retirement established his own company. His wife survives him.—**F. Leroy (Doc) Foster**, secretary, 434 Old Combes Rd., P.O. Box 331, North Chatham, MA 02650

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I received a nice note from Elizabeth S. Kelsey, daughter of **William C. Sessions** informing us that he had died on August 20, 1991, after suffering a stroke. Bill retired in 1984 and moved from Cleveland, where he had practiced patent law for more than 54 years, to California. After graduating from Tech, he received his law degree from Western Reserve University in 1930, and became a law partner in the Cleveland firm of Pearne, Gordon, Sessions, McCoy & Granger. A lifelong member of the Cleveland Engineering Society, he also was a past president of the Cleveland Patent Law Association, as well as other related professional associations. He was a trustee of the Cleveland Health Education Museum, and a member of the Board of Fiscal Advisors of the Cleveland YWCA. He was a member of Bluecoats, the Newcomen Society, Sons of the American Revolution, and several trout clubs. He leaves two daughters, a brother, and five grandchildren.

At this writing in December, your secretary Don Cunningham is doing very well in recovering from his stroke and enjoys hearing from all former classmates.

Don't forget to send notes about what's going on in your life to your class secretary. Those of us who are still around like to keep in touch this way.—**Ron Frazier**, acting secretary, 132 Middle St., Braintree, MA 02184; **Donald S. Cunningham**, secretary, Eventide, 215 Adams St., Quincy, MA 02169, (617)328-1840

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65th Reunion

Paul E. Parker died on August 5, 1991, in Fair Oaks, Calif. A civil engineer, he worked at Stone & Webster in Boston in the 1930s, particularly on hydro-electric plant design. He joined the Navy in January 1941 and became a Commander with

Cardinal and Gray Reunion

Cardinal and Gray Society members can look forward to a variety of activities at their reunion June 3-5, 1992, including a luncheon and the traditional Tech Night at the POPS. On Technology Day, Institute faculty and deans will discuss "How Can American Organizations Excel in the 21st Century?" Questions about the program or how to order Cardinal and Gray red jackets? Contact Nancie Barber at MIT, (617) 253-8217.

the Seabees. He wrote in 1946: "After five years, I have thoroughly enjoyed every minute. My experiences have not been of the blood-curdling type since I have spent most of the time well away from any combat area, as officer-in-charge of construction contracts for an ordnance plant, shipbuilding facilities, and floating dry-docks."

Paul retired from the Navy in 1947 and moved with his wife, Winifred, to California. There he joined the State Public Works Dept. in Sacramento and continued his civil engineering career in bridge and tunnel design. He became project manager and chief design engineer for the subaqueous vehicular tunnel between Oakland and Alameda in 1964, the fourth longest in the world. He retired in 1967. Since then, his hobby has been traveling, mostly as a freighter passenger to Africa. Paul certainly enjoyed a full and accomplished life. His wife died in 1975, and his son Paul Jr. lives in his father's home.

Charles St. George Pope died on July 7, 1991, in Richmond, Va. A long-time resident of San Francisco, he moved last year to Richmond to be with his son Ben, a doctor. An architect, Charles received the Rotch Travelling Scholarship for Architectural Achievement and practiced his profession in California. He finally became architectural historian with the U.S. National Park Service and was an emeritus member of the AIA. He served in the U.S. Army in World War II and retired as Lieut. Colonel. A staunch MIT man, Charley attended our 50th and 60th reunions.

Jack B. Peters died on September 10, 1991, in Lenox, Mass. Following graduation, he attended Harvard Business School and graduated in 1929. He was an advertising and marketing manager for Combes Inc., a pharmaceutical company in White Plains, N.Y. He retired in 1979. During World War II he served in the Signal Corps, stationed at the Pentagon. He continued his service in the Army Reserves until 1952, when he was honorably discharged as Major. He and his wife, Virginia, moved to Greenwood, S.C., in 1979 and then to Lenox, his wife's former home, in February 1990.

We send our condolences to the families of these classmates.

Please write to President **Harold (Bud) Fisher** at P.O. Box 1972, Duxbury, MA 02331; or one of us if you expect to come to our 65th Reunion in June.—**Joseph C. Burley**, secretary, 1 Harbourside Dr., Delray Beach, FL 33483; **Lawrence B. Grew**, assistant secretary, 21 Yowago Ave., Branford, CT 06405

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Again there is sparse news of or from our classmates. I hope that all are aware of and thinking

about our upcoming 65th, in June 1993, an important event though difficult for most to be sure of participation. In due time, we will be receiving information from the Alumni/ae Office regarding reunion plans. Please be ready to respond. We do wish for replies from as many as possible, and additional news which will be passed on to the rest of the class in an appropriate manner.

Peggy and George Mangurian are well and hope to get to our 65th. In the meantime they are enjoying national and international travels. . . . **Alfred Knight** (the judge) intends to join us. . . . **Harlan Paige** continues his valuable service in phone conversations and has been in contact with **Walter Hildick** and **Everard Lester**. . . . **Eleanor Pepper** continues her professional work in New York.

The inevitable attrition of our classmates continues with the death of **George Clahane** on August 29, 1991. George was a structural engineer with the New England Electric System.—**Ernest H. Knight**, secretary, Box 98, Raymond, ME 04071

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A note from **Donald S. Hersey**, East Hartford, Conn., reads: "It is good to reach another year with the help of my dear wife Eleanor. We have had two new events; marriages of two of our grandchildren, one in New York and the other in Oregon. Gardening, household chores, shopping, dining out, and hobbies fill in most of our waking hours." . . . **Frank Mead** of Marion, Mass., and Northport, Fla., writes, "I had a good season in Marion until hurricane Bob came along on August 19. I went to a hotel for the night and following day I found my cellar swamped with seaweed, lost my furnace, hot water heater, and all cellar electric wiring. (Water was four inches.) Deck on lawn—garden wiped out. Insurance paid most of the loss, and I got back to normal in three weeks." Frank's Golf Club closed due to conditions, so he left for Florida early. He plans to return to Marion in May. He concluded, "I miss my Mary dreadfully—life without her is not as pleasant or rewarding."

Richard E. Bolton wrote again from Westmount, Canada. Last September he made the journey to Bath, England, to visit family. "I am planning to go to Ottawa this weekend to celebrate the 25th anniversary of the Heraldry Society of Canada, of which I am an early member, former director and VP, and also an Honorary Fellow. John Fraser, Speaker of the House of Commons, has invited us to have dinner in his premises." It will be a colorful event with tabors, standards, and many members in their traditional Scottish evening dress of kilts, velvet jackets, and frilly shirts. The rest of us will be in dinner jackets or the colorful mess kits of the armed services. Thanks to our efforts, the government has established (with Letter Patent from the Queen) a Canadian Heraldic authority to regulate the granting of arms, badges, and flags."

A note from **Raymond W. Jones** of Fish Hock, South Africa, says, "I retired from Pratt & Whitney Aircraft Co. in 1969 to live in Scotland where year around golf is available. Here in the Western Cape of S.A. since 1983, it is the same story, do some oil painting of landscapes during cold weather; every clear dark night I am out observing variable stars with my 8 inch Celestron." . . . **Rolf A. Zurwell** (wife Polly) of Forest Hill, Md., has sent a note stating that he has completed his work, "Space Energy, the Atom, and Gravitation." This theory combines the three basics mentioned in the title: The atom is revised, and gravitation is defined. Zurwell company continues some detail engineering. "Let there be no mistake—my health, my life of wonderful experiences all come from the one true Almighty God," Rolf writes. Rolf sent me a copy of his thesis which I enjoyed reading.

I regret to report the death of one of our members: **Harry E. Shoemaker** of Temple City, Calif., passed away on February 16, 1991. Three daughters

A Commuter Plane for Every Garage

The year was 1928. Charles Lindbergh had flown the Atlantic. The stock market had no limits; economic growth was accepted as a way of life. Anything was possible. Thus did Manfred Rauscher, '26, who had just joined the MIT aeronautical engineering faculty, and his student Samuel Niedelman, '29, reflect the era's optimism.

For in 1928, they conceived, designed, and began to build a two-passenger, high-wing monoplane that would nip in the bud the growing trauma of commuting. Their craft would sail serenely over the most gridlocked traffic. And after landing, it would fold its wings for easy parking.

To pursue this vision, Rauscher and Niedelman formed Engineers Aircraft, Inc., backed by a number of anonymous investors (including some of Lindbergh's backers and possibly Lindbergh himself). They set up shop in a converted shed in Stamford, Conn., and assembled a team that consisted of two engineers in addition to themselves, four mechanics, one draftsman, one woodworker, one tinbasher, and one painter. Their first product was a 20-foot-long prototype aircraft with a wingspan of 30 feet, called the EC-1.

The EC-1's folding wings were unusual but not absolutely unique among aircraft of the time. But they dictated two other features that were innovations for American small planes: EC-1's fuselage was so broad that pilot and passenger could sit side by side, and the wings in flight position were sharply swept back—22.5 degrees from the perpendicular. Indeed, the EC-1 may well have been the world's first swept-wing airplane.

The wing orientation was a major challenge for the company draftsman, Frank Bentley (then earning the princely sum of \$300 per month for his labors). Everything inside the wing and in its mounting to the fuselage had to be drawn and then built with precisely that 22.5-degree angle. It was a tricky job, and Bentley sent for his brother-in-law, structures expert John White, to come from England for six months to help. White, since then decorated with the Order of the British Empire after a substantial career at Hawker Siddeley Group, is the only member of the EC-1 team still living. He recalls the EC-1 as a



Samuel Niedelman (left) and Manfred Rauscher in front of their creation, the Dodo. The two-person commuter plane got its name from

the strange appearance of the over-size tires, chosen by the designers to eliminate the need for shock absorbers in the landing gear.

"very successful little plane." The project didn't hurt Bentley's career, either; he went on to teach at MIT for 18 years, beginning in 1946.

The first test flight, in the early spring of 1929, was exciting only because the EC-1 performed even better than its designers hoped. Cruising at 130 mph, it was stable in flight, and it had a unique and unexpected aerodynamic characteristic: if the pilot took his hands off the controls, the plane performed not a nose-dive, but repeated and perfect loops.

By the fall of 1929, Lindbergh had lent his prestige to the project by visiting Stamford with several associates, and the plane was also displayed at a New York auto show. There is even one report that Lindbergh himself flew the EC-1 late that year, calling it "a hot plane, very maneuverable."

Even before the test flight, Engineers Aircraft, Inc., was at work on production jigs. The successful test served to confirm their visions of mass production, with prices as low as \$3,800 to \$5,000.

But the company's finances were never very strong. White recalls that when the 90-horsepower Wright Gipsy engine for the EC-1 prototype arrived in Stamford C.O.D., no one had enough money to pay for it. The trucker took it

back to the freight house, where Rauscher and Niedelman later claimed it. In 1930, when boom gave way to bust, the dreams of Engineers Aircraft, Inc., were snuffed out in bankruptcy. The EC-1 was stored, almost forgotten, in the shed where it had been built.

But that is not quite the end of the story.

In 1931, Rauscher and his faculty colleague C. Stark Draper, '26, decided that the EC-1 should fly again. So they dusted off the little plane, unfolded its wings, and flew it to Boston without incident.

A few weeks later, Olof Pearson, '29, a pilot in the Army Reserve, made a short flight with an unidentified guest to demonstrate the plane, including its virtuosity at performing perfect loops. Disaster struck: Pearson suddenly dropped from the cockpit when his leather safety harness failed at the top of a loop over Boston Harbor. The passenger, not a flier, cast himself loose, and both floated to safety on parachutes, making "spectacular landings within sight of thousands at Revere and Winthrop beaches," in the words of the *Winthrop Review*.

Meanwhile, EC-1's graceful loops eventually terminated in an equally spectacular splash, bringing the story—until now almost unknown in the annals of MIT—to its melancholy end.—John Mattill □

ters are reported among survivors.—**Karnig S. Dinjian**, secretary, P.O. Box 83, Arlington, MA 02174, (617) 643-8364, Dec. 1 to May 1 (407) 395-2890

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Those who returned for our 60th Reunion will recall that both **Al Luery** and **Hal Spaans** attended as widowers. At the class dinner at the Hampshire House, there was discussion about the virtues of second marriages, which appears to have borne fruit. Al's December 1990 marriage to Maxine MacFarlane was reported in the August '91 notes. Now Hal Writes that he has "followed in Al's footsteps"; he and Alice Margaret (Peg) Davis were married in Bryn Mawr, Pa., in April 1991. Hal and Peg met at Willow Valley Lakes Manor, near Philadelphia, where Hal and his first wife Marge had moved some years earlier. Peg's first husband, a physicist with Kimberly-Clark, died several years ago, and she then went into teaching, most recently at a high school in Philadelphia. Hal says, "We have merged our two families successfully." They now have six children and ten grandchildren.

The 75th anniversary celebration of the Chemical Engineering Practice School on October 4-5, 1991, was generally well attended, but not by the Class of '30—**Dick Wilson** and I were the only classmates participating. Dick looks well and reports that he still skis at the Swain Ski Area near Rochester, N.Y. He also continues to figure skate.

"Doc" Foster, secretary of the Class of '25, has kindly forwarded an interesting newsclip from the September 1991 issue of *Mining Engineering* about **Bob Henderson**, who died in 1965. There is a National Mining Hall of Fame in Leadville, Colo., in which Bob was recently "enshrined." Bob had a long and distinguished career with Climax Molybdenum. At the time of his death, he was general manager of their western operations. Quoting from the newsclip, "Under Henderson's guidance the Climax mining operation came to be recognized throughout the world as a leader in innovation and production efficiency. . . . Underground mines throughout the world sought to imitate the mine's incredible record of productivity. . . . It is fitting that the world-class molybdenum deposit near Empire, Colo., discovered under his leadership, was named the AMAX Henderson Mine in honor of this great leader and mining man."

Frank Hankins' early retirement because of Parkinsonism and his move to Ft. Pierce, Fla., with his wife Anne have been previously reported. Apparently he is still able to do some sailing, as well as woodworking, especially with Florida mahogany. He would very much like to have a visit from any classmate who happens to be in the area. Their older son Tim is a professor of radio astronomy at the University of New Mexico and works with the Very Large Array near Socorro, N. Mex. Son Frank is a Northwest Airlines captain, and daughter Anne lives in Old Lyme, Conn., where she is Parks Commissioner.—**Gordon K. Lister**, secretary, 294-B Heritage Village, Southbury, CT 06488

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The past October and first week in November have had unusual weather. We did not get a killing frost until November (the end of September is common). This past week a strong northeast wind brought high tides and the largest waves I have ever seen, causing tremendous damage along the Maine, New Hampshire, and Massachusetts coasts. The last day of the storm, October 30, three of us golfers started out on the front nine at the old Wentworth Golf Course and in spite of the wind did fairly well for five holes, then on the sixth, with the tide still over an hour from being high, we gave up as the salt marsh

adjacent was completely flooded and the next two holes ahead were being showered with spray.

The Wentworth Golf Course is an adjunct of the old Wentworth Hotel in New Castle, which many of you probably remember. It was the place where the Russian and Japanese delegates to the Russo-Japanese Peace Treaty of 1905 lived. The Treaty is called the "Treaty of Portsmouth" because the delegates did their work and signed the treaty at the Portsmouth Naval Shipyard. Unfortunately, two of the three original buildings of the hotel have been torn down, and the last reminder of that historic occasion is in disrepair and soon may be gone.

Mildred and I took a ride to the beaches the next afternoon and found front-end loaders clearing the sand and stones from the road. We had to detour around one section where the sea had taken out a stretch of the road.

Alfred Ziegler (BS in chemistry, MS in metallurgy) died September 10, 1991, at his home in Palmer, Mass., where he had worked at the East Coast plant of Colorado Fuel & Iron Corp. (formerly Wickwire Spencer Steel Co.) for 40 years, serving variously as department superintendent, assistant manager and finally East Coast manager, retiring in 1972.

He was involved in many local organizations, having been chairman of the investment board of the Palmer Savings Bank, trustee for the Second Congregational Church, the Palmer Public Library, and building committee member of Wing Memorial Hospital when an addition was built. He was a member of the Palmer Rotary Club for 30 years and chairman of its scholarship committee; and with his wife, active with the high school age Youth Fellowship and with Operation Friendship of his church which participated annually in exchanging young students of foreign countries. He was also a committeeman with Pioneer Valley Boy Scout Council and with his wife gave many years to the scouting movement.

In addition, Alfred was an ardent skier, and after retirement he kept himself available as a ski slope service consultant, specializing in wire rope problems in the ski industry.

Besides his wife Margaret, he is survived by two sons, two daughters, and a sister.

Murray J. Lalone, of Closter, N.J., has been reported as deceased, but I have no particulars as to when, or who survived him. Any information would be greatly appreciated.—**Wyman P. Boynton**, secretary, 668 Middle St., Portsmouth, NH 03801

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60th Reunion

Our class officers are thinking about our 60th Reunion. Here are some statistics that many classmates have requested. At our 50th Reunion we reported 399 active members, 282 deceased, and 63 status unknown. The 96 class members who attended reunion and their guests totaled 175 attendees. We received \$25 in class dues from 140 classmates. After subtracting all expenses including the class book, the net profit for the 50th Reunion was \$300. At our 55th Reunion, 34 classmates attended—with guests we had 70 present. Our class dues were \$10 per classmate and our total loss on the reunion was \$2,300. We had hired professional entertainment for the banquet.

We now have 234 active class members. The Alumni/ae Association has forecast our 60th Reunion to be attended by 34 classmates totaling 50 with guests.

At our last class meeting it was decided to ask for voluntary class dues of \$25. This would give our class treasury a few extra dollars so that a few extra touches can be given to our reunion as well as an attractive directory of all contributors.

This is a good time to call your attention to Project 2000—part of the "Campaign for the Future." MIT wants to upgrade or renovate the core teaching facilities before the year 2000. The names

of all donors to Project 2000 before June 30, 1992, will be engraved in a plaque that will be mounted on campus proudly and prominently. To honor your gift of \$500 or more, the Alumni/ae Fund Board will send you a further token of thanks: a piece of the original steps of Building 7 — MIT's main entrance. Your "Piece of the Steps" will rest on a handsomely carved wooden base for your desk or coffee table, and will be accompanied by a certificate of authenticity.

This is our way we can help keep MIT preeminent among institutions of higher learning.

I met Dr. **Albert Dietz** and his wife Ruth at the Boston Seminar Lecture. They inform me that they are finally going to move to the "Gables," a retirement community in Winchester, Mass. . . . **Robert Dunlavy** informs us that he and his wife Fran are in good health. He is retired and busy with local associations. They proudly report that they have 23 grandchildren. Can any classmate top this? . . . **John Zouck** hopes to go hunting. He never attended any reunions but he hopes to come to our 60th.

We want to give recognition and thanks to Mrs. **Henry F. Worcester, Jr.** for her continuous generous support to her husband's memorial fund. Henry owned a laundry business outside Washington, D.C. He was the president of the Dry Cleaners Association and ran their research center at Silver Springs, Md.

A personal note. I'm a better tennis player than a golfer. I have a golf handicap of 30, and when I break 100, I've had a good day. At our golf club we have a Super Senior Tournament (one must be 70 years or older). In the finals everything clicked—I shot a 96 and won the coveted honor.

There's fewer of us now, classmates. You must keep writing. If I'm not to miss appearing in each issue of the magazine.—**Melvin Castleman**, secretary, 163 Beach Bluff Ave., Swampscott, MA 01907

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The committee for the 1993 reunion (60 years, holy smoke!) met at MIT last September—Messrs. **Johnson**, (Mrs. Johnson), **Bachli**, **Britton**, **Fossett**, **Greer**, **Hayden**, **Huston**, **Meyer**, (Mrs. Meyer), **Rhodes**, and **Webster**. First affair: June 2, 1993, 12:00 noon. Kindly mark your calendars carefully. **Charlie Britton** says our choice of the Sheraton Tara was checked out and found to be wonderful. We will give you further data in timely fashion.

Mel Ehrlich has been selected to receive honorary membership in the National Lubricating Grease Institute and was honored October 29 at the industry's banquet in Phoenix—"for his many years of service on the Technical Committee, editing work on the NLGI Lubricating Grease Guide, and contribution of technical papers."

News of your eminent president—one **Richard Fossett**: he has been very active running around the world—went to Switzerland with his dear wife, where it was cold in Wengen (if you've never been there, see it—it's gorgeous). They looked at the Zermatt and visited their grandson at the Bitburg base.

Ivan Getting appears to be very active in his radiation consulting work. His schedule is very full and he's going all over the country.

Warren S. Daniels, who spent about 40 years with the U.S. Geologic Service (since 1969 as chief of the Program Planning Division), retired in 1976. Thereafter, with Mrs. Daniels, he operated a travel agency in Annandale, Va. Recently, he has undergone cancer therapy. He can be reached at home, 7208 Statecrest Dr., Annandale, VA 22003, (703) 560-3326.

Gerard M. Kincade died June 20, 1991; Mrs. Kincade is at 717 Windvue Dr., Pittsburgh, PA 15205. . . . **Waldron S. MacDonald** died August 30, 1991; Mrs. MacDonald is at 429 Williams Rd., Concord, MA 01742.

We (you and I) are doing a lousy job of obtaining information about ourselves for publication in this column. The main reason for this is that many bright people are bashful and will not

voluntarily reveal their better points without urging. When I was an Educational Counselor for MIT 20 or 30 years ago, I interviewed a boy in Warren, Ohio, and had a helluva time getting anything out of him. Finally, he admitted to going to Florida the prior winter. I kept digging at that to learn that he had been invited by Mr. Johnson. Who, pray tell, was Mr. Johnson? "You know, the president of the United States." It seems our young hero had won a national contest for space flight propulsion ideas.

That's my problem with you guys and girls. If you don't confess, I have nothing to report, other than obituaries. I remain, your humble class secretary.—**William B. Klee**, secretary, P.O. Box 7725, Hilton Head Island, SC 29938

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Apology: E. Philip Kron, guest columnist for November/December 1991, was inadvertently listed as secretary.

Please send news for this column to: **Robert Franklin**, secretary, P.O. Box 1147, Brewster, MA 02631; **George Bull**, assistant secretary, 4601 N. Park Ave., Chevy Chase, MD 20815

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Our class president, **John F. Taplin**, sent the following letter to me October 1 requesting that I include it in my next class notes *without any changes*. I admit to mixed feelings about this (I don't like to toot my own horn), but if it produces letters from you, especially those who have not been heard from since graduation, then it will be worth it.

"To: **Allan Mowatt** and the Class of 1935. Several months ago I attended an excellent class officers' training meeting run by Diana Strange, senior director of Alumni/Ae Activities, and Eliza Dame, program director of Reunions and Special Events. During the meeting they pointed out certain actions and activities employed by MIT class officers that have proven to be most effective. We learned that by providing frequent class news—describing activities and interests of the classmates—the percentage of participation of graduates in MIT's events and the level of graduates' generosity in response for support from the alumni/ae were excellent.

"As I reviewed the notes provided at the meeting, I realized that our class secretary, Allan Mowatt, has established a most unusual record for the past 25 years. Allan has been searching out and writing up our class notes for all these years so that we might be able to follow the activities of our classmates. We are all indebted to Allan for the many hundreds of hours of effort he has expended in providing us with this information. In recognition of Allan's unique contributions as our secretary for these past 25 years, he was given the Harold E. Lobdell '17 Award during the Awards Luncheon of the Alumni/ae Leadership Conference at MIT on September 21. The award recognizes the special achievements of MIT's most outstanding volunteer for serving more than 20 years as class secretary, and for loyal and dedicated hard work in cultivating a spirit of unity between the Institute and its alumni and alumnae essential to continued growth and success of the Institute and the Association of Alumni/ae of MIT."

"In view of Allan's years of efforts as our most faithful class secretary, now is the time to really show our appreciation by mailing him at least two letters every year. He and our classmates will be pleased to know what you have been up to during the last few years and what plans you may have for the coming year. So, please drop Allan a line to prove to him that his work in gathering class information and writing our class notes is really appreciated by all the members of the Class of 1935. Sincerely, John."

I had a nice phone call from **Leo Dee** from

Brewster, Mass., telling me that he and Janice were closing up their summer home and leaving for Boynton, Fla. Last June they went to MIT at the Pops with two of their grandchildren. He and Janice made an Eastern Mediterranean trip during the summer, including visits to Greece, Cyprus, Turkey, and Israel. In Egypt they took a Nile cruise to the Aswan Dam. Leo's son James lives in Texas and is professor of Latin and Greek at the University of Illinois. Son Thomas is general manager of the Bottled Drinking Water Division of Ionics, Inc., in Holliston, Mass.

A news article in the Brockton, Mass., paper tells of the 50th wedding anniversary of Frances and **John Snow**, residents of Whitman, celebrated with the help of their three children: Carol, John Jr., and Helen. John enjoys stamp collecting, fishing, and Masonic activities, while Frances is an active member of the Whitman Woman's Club and Eastern Star.

Diana Strange sent me an updated list of our class membership. The new list has 138 additions to our class since the list dated September 10, 1990. If you had a friend from our undergraduate days who just "disappeared," write to me and maybe I can get some answers. Here are some of those that I remember: **John P. Bainbridge, Jr.**, **Marshall Ballard, Jr.**, **J. Howard Beck**, **John A. Bradshaw**, **Winston A. Close**, **Edward K. Dougherty**, **Carl F. Floe**, **Thomas E. Foley**, **Leslie Guy Haines**, **Herbert P. Haley**, **David B. Langmuir**, **Rush B. Lincoln, Jr.**, **Frederick F. O'Brien**, **Robert G. Pierce**, **Charles H. Schauer**, **Eugene F. Schwarzenbek**, and **Charles E. Ware**. Ring any bells?

I hope you and yours had very happy and healthy holidays.—**Allan Q. Mowatt**, secretary, 715 N. Broadway #257, Escondido, CA 92025

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On my way to reunion, I saw **Bill Prudente** (Course I) who recalled civil engineering connections with **Al Bagnulo**, **Elliott Robinson**, and **Bernie Gordon**. Bill's career included 25 years with Stone and Webster, where he helped bring the Connecticut Yankee nuclear plant on line on schedule in 1967 and worked on design and supervision of a Virginia electric plant. . . . **Jim Demakes** was adjusting to a pacemaker inserted only two weeks earlier, and so far so good. He was Course X but finished at Bentley College. Then followed 30 years with S.S. Pierce, heading its computer department. Jim returned to Bentley as a faculty member for 16 years, retiring in 1986. He is lieutenant colonel, Army Reserve, rising from private to sergeant in freshman ROTC and the rest of the way in 26 years of active and reserve duty.

I was unable to find **Bill Metten** (Course VI) in Quincy, Mass., but we visited by telephone in August. As an MIT student, Bill had to take a year off to repair finances, and he joined '36 for junior and senior years. His thesis partner was **Phil Norton** (deceased '88), and he spoke of **Harry Foster**, now living in Hawaii. Following graduation, Bill worked for four years with Professor **Robley Evans** in MIT's cyclotron laboratory and then had a long career with GTE-Sylvania, with some studies in metallurgy at Tufts. Bill is strong on music and often has a balcony seat at Pops for Tech Night.

The reunion videotape taken by **Harry Essley** included tennis doubles between **Peg and Fletch Thornton** and **Vivienne and Eli Grossman**. Janet and **Bob Gillette** and the Phillips found a rental centerboard sloop in Hyannis for an unusual sail in the bay: after the renter rowed us into open water (no auxiliary power), we found the centerboard jammed in the up position. Comes the ferry starting its run to Nantucket, horn blasting at this pipsqueak intruder. But First Commodore **Bob's** expertise with sails and rudder got us out of harm's way. More on reunion in next issue. Please call or write **Pat Patterson** or me with the ventures we were not privy to.

Dick Denton writes of visiting **George Robinson** and Virginia at their Martha's Vineyard cottage. They played golf at the Vineyard Country Club, where Dick caddied as a boy—18 holes for 75 cents including tip! Last winter Dick had a call from **Ben Dayton** (Course V) who "was applying to University of North Carolina so he could add a PhD in physics to his SB from MIT and University of Rochester MS. He was accepted and I am sure all the class will pray or cheer for him."

Dick, whose son Peter is Class of '67, went on to write that his eldest grandson, **Tarik Saleh**, would be entering Tech in the fall. **Tarik's** father, **Adel**, who is from Egypt, received a PhD in electrical engineering from MIT in 1970. . . . In the devastating October fire at Oakland, Calif., **Bob Tripp's** home was saved by the fire companies' work just three blocks away! With the fire advancing from two sides, **Bob** and **Lilyane** had packed treasures into their cars, but they were able to sit it out. My call a week later found them recovering—"Lilyane was badly shaken and near tears for several days but has recovered now," said Bob.

A letter from **Ken Winsor** (Course IV) in Italy expresses his regrets at being unable to attend the 55th. "One would think that an old globe circler like me would have some time landed at the boathouse, or atop the dome, or even splashed down on the newly crystal-clear Charles River. Seriously, we had planned to attend, but the usual emergencies (deadlines) interfered. Never have we visited Cambridge together, nor the aviation cadet reunions." Replying by telephone, I urged him to keep in shape so we can have him in the 60th Reunion crew. Since retirement from Lufthansa Airlines, **Ken** has continued his renowned work in sculpture for clients in Europe and the Middle East. **King Hussein** of Jordan commissioned one of his works.

Classmates! As you know, 1936 has used more than its share of column space in several issues the past year or so. Rightly, I have been taken to task by the managing editor, and you may have noticed less verbosity beginning November/December. As to content, we just don't have many babies, promotions, awards, or achievements any more. But we do have rare recollections, like flying a "paper cub" on a weekend from Norwood Airport to Washington without landing lights, or solving a P-38's rollover tendency, and all manner of odd experiences of yesteryear—"ancient history" yes, but interesting to all. So keep them coming! **Pat Patterson** and I will do our best to get them into print.

Let's give cheers for the lives of **Clint Young**, **Al Del Favero**, and **Claxton Monro**. A letter from **Clint's** widow **Mary**, with an obituary from the *Washington Post*, tells of his death of a heart attack March 30, 1991. He was Course VIII, and combined optics and electronics in numerous applications. He was awarded some 20 patents and was listed in *Leaders of American Science* and *Who's Who in Engineering*. **Clint's** Outlook Engineering Corp., founded in 1954, developed color map scanning equipment for the Army, a scanner for GE's jet engine castings that distinguishes harmless pinholes from tiny cracks, subsurface thermal probes for forest fire fighters, and many other sophisticated devices that benefit the nation's economy and safety. . . . **Al Del Favero** (Course I) died September 18 of a brain tumor. When I visited him a year earlier (January '91 Notes), he seemed in good health, and we talked at length about his career in construction. He worked on major buildings far and wide and carried out wartime construction under fire in the Navy Seabees. His widow, **Ella**, said the tumor was unnoticed until April and that **Al** died without great pain. She continues at 1133 Countrywood Lane, Vista, CA 92083.

A news clipping forwarded by **Larry Peterson's** daughter tells of **Claxton Monro's** death September 20. He was Course XV and Tau Beta Pi, but after a few years in business found his calling in the ministry, to the great good fortune of the thousands he touched. **Clax** retired in 1981 as rector of St. Stephen's Episcopal Church in

Houston, but continued working to involve lay people in church work, and published a book, *Witnessing Laymen Make Living Churches*. He has been in these Notes almost yearly, thanks to classmates telling us about his visits or correspondence. His widow Victoria continues at 4702 Red Stone Court, Austin, TX 78735. On the telephone she told of his dying suddenly of an embolism to his heart from a prostate cancer operation, and that on waking that morning he said, "It is going to be a glorious day!"—**Frank L. Phillips**, secretary, 1105 Calle Catalina, Santa Fe, NM 87501, (505) 988-2745; **James F. Patterson**, assistant secretary, 170 Broadway, Pleasantville, NY 10570, (914) 769-4174

37 55th Reunion

Make your reservations now for our 55th Reunion! Newport, R.I. is beautiful, historic, charming, and very interesting, and the scheduled events at the Institute are outstanding! Don't miss it—plan to attend.

More on the survey relative to our classmates' involvement in MIT activities: **George DeArment**, **Jim Ewell**, **Bob Ferguson**, **Joe Keithley**, **Dr. Charles Reed**, and **Phil Peters** are Corporation Development Committee members. **Phil Dreisegacker**, **Richard Hutchinson**, **Win Johns**, and **Norm Robbins** are Educational Council members. The Class of '37 was not large, but our members are active and involved.

Received a welcome letter from **Ernie Ferris**, who writes, "The news I've got to pass on is about **Dom Cestoni's** 50th wedding anniversary surprise party in, or near, Brickton, N.J., last June 4. My wife and I attended, and we were pleased to see **Bob Bauer**, and his wife, who were up from Florida. It was a very pleasant reunion for we three who had also gone to Boston English High School together. Dom has retired from his world tours for Merck, Bob retired from Standard of Indiana, and I from Borg-Warner. After the celebration, Dom and his wife Phyllis decided to see the USA. They have a daughter in California, a son in Georgia, as well as a daughter or two in New Jersey. On their way East again they dropped in to visit us in Chicagoland, so we had more time to renew our memories of old friends and old times, and brag about our children and grandchildren. Dom reminded me that at his wedding I was responsible for the moving pictures, but somehow both reels were blank—because even though I could see through the viewing lens, I forgot to remove the cap on the picture-taking lens. We hope to see you in good health at the 55th."

Sorry to report that **Charles F. Healey** passed away August 1, 1991. Charles was an electrochemical engineer, but changed careers in mid-life when he obtained a master's degree in library science from Rutgers University in 1964. He was employed as a librarian at the New Jersey Institute of Technology for 18 years before retiring in 1982. He leaves his wife of 40 years, **Charlotte West Healey**, a daughter, a son, and two grandchildren.—**Robert H. Thorson**, secretary, 66 Swan Rd., Winchester, MA 01890

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Our principal news this issue is of the fascinating trips of the Homers and the Hopgoods, each couple having visited the Pergamon Museum in East Berlin.

Roberta and Horace Homer on the Alumni/ae Association's Danube trip spent the first two days in Istanbul, where their group and the MIT Club of Istanbul enjoyed a joint cocktail party. Then by steamer up the Black Sea to Ismal, Russia, to board the Danube riverboat. This turned out to be less than routine. The Danube happened to be at its lowest level in years, so the tour had to transfer to a smaller boat. Then they awoke one morning at Belgrade to find three Yugoslavian gunboats off their stern, with the Danube closed

to river traffic the next several miles. So they transferred to buses to meet a sister ship coming downriver from Vienna, only to receive news of fighting three miles away in Vukovar, which now meant busing all the way into Hungary (at least they got to see more Yugoslavian countryside). Of the 160 on the tour, 35 were from MIT. One was a retired MIT professor, who enhanced the trip with a series of talks on the Balkans. Until the next issue, we'll leave the Homers at the Danube port of Baja, Hungary, looking for the boat for the next leg of their journey, including Austria and Germany.

Hoppy Hopgood called Horace to say they would miss the mini-reunion at Endicott House in June because of an MIT Quarter-Century Club expedition that would include Berlin. Horace insisted that they be sure to visit the Pergamon Museum in East Berlin. The museum was an archaeological rival of the British Museum and the Louvre until closed off from the rest of the world by the Berlin Wall. It takes its name from the great Altar of Pergamon—a site Hoppy had visited in the Asia Minor part of Turkey on a prior Quarter-Century trip. They found this East Berlin museum so impressive that they went back a second time. As Hoppy wrote: "We've never experienced anything like it, and we hope to be able to revisit before modern Turkey stakes its claim before the World Court to have the whole thing sent back to its homeland." Their excursion included classic points along the Elbe River and its tributary, the Moldau—Czechoslovakia's longest river. Highlights were Prague, Dresden, Meissen, and Torgau, the latter being the meeting place of Russian and U.S. troops at the close of World War II. The trip turned out to be quite exclusive; a major fraction of those who first signed up canceled because of unsettled conditions surrounding Desert Storm.

The Hopgoods had earlier signed up for a Kenya/Indian Ocean trip (Quarter-Century sponsored). But here, too, because of Desert Storm, the Kenya safari was reduced to 24 and the Indian Ocean to 35 tourists—on a luxurious new vessel featuring a crew of 72. Their ocean trip included stops at several islands between Kenya and the island of Madagascar and thence to a half-dozen spots among the Seychelles.

Now for the news we neither like to write nor like to read. **Walt Blake**, '37, sent a clipping on the death on October 24 of **Gordon Foote**, who earned both an SB and PhD in chemistry. Following graduation, his entire professional career was with Proctor and Gamble. He worked in Product Development and Technical Recruitment at the company's R&D headquarters in Cincinnati, Ohio. He was active for MIT, and I often saw him in my MIT Club trips when I was on the association staff. Twelve years ago he moved to Columbus, N.C. During World War II, Gordon, on leave of absence, held the rank of major in the Army Chemical Warfare Service at its headquarters in Edgewood, Md. Besides his MIT activities, he was active in home health care services and youth development in the inner city.

George Shea, a graduate of the Communications Option of Electrical Engineering, died last August 26. He had been a resident of Bedford, Mass., for the past 32 years and prior to retirement was a radar and electronic engineer at Hanscom Field Air Force Base. An avid organist and pianist, he was a member of the American Theatre Organ Society.

Warren E. Thomson died unexpectedly June 22 at his Edgewood, Md., home. He began his career with the U.S. Government in physical science administration. Later he was assistant director for an MIT Operations Evaluation Group at the Navy Department in Washington. He was a staff member, and subsequently acting chief, of the Analysis Branch Office of the Director of Defense Research and Engineering. As director of Media Development for Gallaudet College, he produced instructional films, video tapes, and other educational materials. He wrote instructional TV scripts for the Corps of Engineers, U.S.

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Army, and Federal Aviation Administration. His publications include 30 instructional texts, several classified reports, and three children's books. Active in community theater, he recently wrote and produced a highly successful play for performance last June by the Parish Players of his parish.—**Don Severance**, secretary, 39 Hampshire Rd., Wellesley, MA 02181; **Ed Hadley**, assistant secretary, 50 Spofford Rd., Boxford, MA 01921

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Clint Lawry and **Faith** celebrated their 50th wedding anniversary in Schenectady, N.Y., with a dinner attended by family and friends. Clint's 42-year achievements with General Electric included contributions to reactor rod control and safety systems for nuclear power plants. With others in 1957, Clint shared the Charles A. Coffin Award for development of integrated electronic controls for jet engines. . . . **Seymour Sheinkopf** and **Sylvia** commuted pleasantly last summer between their apartment in Burtonsville, Md., and their motor home parked in a New England wooded setting. On return to Maryland they reported that **Art Zeldin** and **Helen** were about to start a tour of New Zealand and Australia.

Bob Schmucker and **Jean** toured Europe for several months and write: ". . . north of Heidelberg we visited Michelstadt, which Jean recalled was the ancestral home of the Schmuckers. Following up an old rumor, we found a Schmucker brewery about five miles away and bought a case. At the end of our trip we returned to Munich and mastered its subway system (it won't work in New York). On return to the U.S. we saw **Bob Touzalin** and **Aletta** and learned they had driven through Munich the same week we were there. . . . Neither Bob S. nor Bob T. reported any judgments resulted after sampling "Schmucker's Premium."

George Hulst extended his harmony hobby (SPEBSQSA Barbershop style) by being accepted for the annual international tour of the Johnny Appleseed Barbershop Singers. George and **Lillian** joined the group to present two weeks of barbershop chorus and quartet concerts in New Zealand and Australia. George's travel notes reveal the enthusiasm of thousands of listeners "down under." Hopefully, George and **Lillian** will join **Fred Cooke** and **Eugenia**, **Morrie Nicholson**, **Win Reed**, **Nick Carr**, and other '39-er afterglow harmony buffs at songfests at our 55th.

Fred Grant, chair of our 55th Reunion Committee, received about 50 responses from classmates regarding preferences for time, place, and other details. About 50 others have not been heard from. Their letters to **Fred** at 22 Edmunds Rd., Wellesley Hills, MA 02181 will help.

We are saddened to report the death of **Mortimer A. Schultz** on June 29, 1991, at Mashpee, Mass. His career achievements were many, including 29 years with Westinghouse in radar, sonar, nuclear instrumentation and control for submarines, and project management of the Westinghouse Testing Reactor. He was president of Millitron, Inc., manufacturer of Nuclear and Industrial Instruments and Controls. For 13 years he served as professor of nuclear engineering at Penn State University. He was professor emeritus and consulted in fields of ultra-safe reactors and advanced controls. He authored *Control of Nuclear Reactors and Power Plants* and 130 articles. He served as advisor to the United Nations and on the President's Research Advisory Committee on Nuclear Engineering Systems of NASA.

Also, we are sad to report the death of **Harold H. Butler** on May 2, 1991, in Nutley, N.J. There were no details.—**Hal Seykota**, secretary, 2853 Claremont Dr., Tacoma, WA 98407

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Alvin Gutttag sent a note from his new home at 415 Russell Ave., Apt. 108, Gaithersburg, MD

20877. "We sold our house in Bethesda in June after 14 years in Bethesda and moved to temporary quarters at Grosvenor Tower in Rockville, Md. On September 11 we moved to our permanent new address. It is a brand new three-bedroom apartment in a nice, well-established retirement community. Still trying to fit things in."

Past class president **Jim Baird** attended a Chemical Engineering Practice School symposium that studied the school's past and future. Jim sent a note to tell me that I missed a good party. At the meeting he saw **Russ Haden** and **Bill Stern**, as well as acquaintances from other classes.

Recently, **Sybil** and I had lunch with **Rhoda** and **Amos Joel** near their home in New Jersey. Amos continues to be very active consulting, primarily with AT&T. He is involved in litigation and has served as an expert witness. The Joels have been in touch with **David "Beano" Goodman**, who recently returned from a trip to Great Britain.

Arnie Wight writes from Amherst, N.H., "**Wally Schuchard** and his wife **Peggy** came by on October 11 for a delightful visit. We learned of the great celebration of their 50th wedding anniversary this year. Betty and I added a toast with New Hampshire apple cider while enjoying the warm sun on our deck overlooking our Beaver Brook. I was in the process of getting out copies of my recent letter to the Secretary of Energy and his advisory board task force on radioactive waste management."

A recent letter from class president **Norman Klivans** was addressed to other class officers **Phelps Walker**, **Martin Abkowitz**, **Dick Babish**, **Walter Helmreich**, and former officers **Jim Baird** and **Edgar Bernard**. In the letter, Norman laid out a tentative program for the 55th Reunion in 1995. "The broad plan is to start in Cambridge Wednesday PM prior to Tech Day, have some class activity on Thursday, join the alumni/ae events Thursday PM and Friday AM, then go to Newport on Friday noon and remain there through Sunday noon. Sightseeing will be arranged on Saturday.

There would be cocktail parties each evening, but no big sitdown banquet. Instead, we would try to arrange more informal deals, like the clam-bake at Mystic. If these ideas don't fit your thoughts, let's hear from you. There is plenty of time for changes and improvements."

Norman also told of his visit to **Walt Helmreich** in Ann Arbor, Mich. They discussed the mini-reunion in January 1993, and Margaret observed that, in addition to the classes of 1939 and 1941, it might be a good idea to include 1938 and 1942. If there are no objections, that will be explored.

I recently assumed the position of chair of the Boston SCORE Chapter. It looks as if it will be a very satisfying year, but will involve a lot of administrative work.

There are two obits this month. **Earle D. Benson** died suddenly August 26, 1991. He was an electrical engineer and was employed as a manufacturer's representative of electrical engineering goods, according to the *Woburn, Mass., Daily Times Chronicle*. . . . **Augustus P. Norton** passed away last February 22. There is no further information.

Your letters and notes are what keeps this column going, so keep them coming.—**Richard E. Gladstone**, secretary, 1208 Greendale Ave., Needham, MA 02192, (617) 449-2421

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The 1990-91 Report of the President (MIT) highlighted well-deserved special appointments for two of our classmates. **Carl M. Mueller**, "who for more than two decades served MIT as a member of the Corporation and three presidential search committees, of which he chaired two, was named an honorary lecturer by the Corporation—a rare action—in recognition of his trustee leadership and unparalleled contributions." . . . **David S.**

Saxon, "who served as Corporation chair from 1983 to 1990, was named honorary chair, succeeding Howard W. Johnson, who resigned to permit Saxon's election to the position."

A long letter from **Bob (Wallace) Blake** details his activities since the reunion: "On the way home stopped in Tiverton, R.I., to visit fraternity brother **Bill Freeman**, '42, and in Stoneybrook, N.Y., to visit fraternity brother **Bill Schoen**, also '42. Both Bills are retired and have offspring on the West Coast, whom they sometimes visit." . . . Cecily and **Ray Berry**, driving west from the reunion, stopped to see **Bob** in Seattle. This led, in September, to a "Course XVI mini reunion at the Berry's beach-side home in Long Beach, Calif. Additional attendees were **Mal Abzug**, **Harry Heimer**, **Frank Meyer**, and their ladies."

Bob also visited Scandinavia and Russia from July 29 to August 19. In the first few days, he managed to help a Seattle friend locate ancestral homes near Oslo, Norway, and from August 14-17, he visited Leningrad and Moscow, just before the aborted coup on August 19. The whole story deserves recounting by **Bob** in person!

John Murdock, responded to **Sepp Dietzgen's** invitation to recount our recent athletic activities (*Technology Review*, July/August 1991). An enclosed copy of an ABC News video tape showed him swimming against the current in his invention, "The Endless Pool." **Sander Vanocur's** voice-over: "If you are one of the 20 million Americans who call themselves swimmers, and if you are all wet and getting nowhere, then maybe this is for you!" John's son (also John) is marketing these machines and appeared in the video as did his grandchildren.

A suggestion for you contributors to MIT. Although I left a corporation in 1962, I became eligible for a small vested retirement in 1985. This year I discovered that the benefits include a matching gifts program that I had been ignoring for five years! MIT can provide you a list of corporations that match gifts of active or retired employees to MIT. You can get the Matching Gift Form from your corporation. By submitting it promptly to MIT, you may double your contribution to MIT for last year. Future submissions would double each future contribution!—**Charles H. King, Jr.**, secretary, 7509 Sebago Rd., Bethesda, MD 20817, (301) 229-4459

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50th Reunion

Our 50th Reunion events are shaping up. Your registration form should be arriving in the mail soon, so save the dates June 1-5 for our reunion in Cambridge and Woodstock. Also, we look forward to leading the Commencement parade June 1.

Let's see you all there for the biggest and best 50th Reunion ever!—**Ken Rosett**, secretary, 281 Martling Ave., Tarrytown, NY 10591

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Hans Walz wrote from his summer retreat in Jaffrey, N.H., to say that he and **Vicky** are well and enjoying life. His latest toy is a 16-foot Alden ocean shell, with which he roils the waters of Lake Contoocook. He navigates using a rear-view mirror attached to his eyeglasses. This, of course, converts port to starboard, and vice versa. . . .

The *San Francisco Chronicle* reports that **John G. Linvill** (Course VI) continues as professor emeritus at Stanford and is also a newly elected director of Read-Rite Corp. of Milpitas, Calif. . . .

Dick Haas has checked in from Cuyahoga Falls, Ohio. He retired from Goodyear in 1985 but keeps active by traveling and by serving as a dispute arbitrator for several state and national organizations. He gave up squash and flying last year, although he maintains good health and his golf handicap is an incredible eight. Dick is now coasting comfortably toward our 50th Reunion.

I finally got news from **Hugh Parker** the hard

way: I went to London after it. In a short but enjoyable tête-à-tête, he recounted his history. Before World War II, Hugh, a New England native, attended Cambridge University in England. After a September 1939 visit to the U.S., he was unable to return to Britain because of the war, so he entered MIT. Instead of staying on to graduate, however, he left to help operate a North Carolina shipyard, where he worked during and after the war. In 1951, he joined McKinsey & Co., and in 1957 was sent to London to open a branch office, an 18-month assignment that continued until his retirement in 1984. Following retirement, Hugh began to accept corporate directorships in the U.K. This led to his becoming in 1987 chair of Corporate Renewal Associates Ltd., another management consulting firm, from which he will soon take his second retirement. Hugh has been active for many years with MIT's Industrial Liaison and Corporate Development Programs, for which service he received the Bronze Beaver and Dalton Bowl awards. After giving up his duties with CRA, he will continue efforts on behalf of the Institute, helping President Vest to make contacts to enhance the MIT presence in the U.K. Hugh recalls that, as an undergraduate, he once engaged **Vergilio Barco** in a boxing match. He claims it was Parker over Barco by a K.O.

Vergilio is still Colombia's ambassador to Britain, with headquarters near the world-renowned Harrod's department store. I tried to arrange an appointment, but our schedules wouldn't mesh. Perhaps I can interview him at the 50th.

I did get these stories in London, but don't count on my coming to your hometown for your life history. Use the U.S. mail.—**Bob Rorschach**, secretary, 2544 S. Norfolk, Tulsa, OK 74114

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These notes are being written in the glow of the good time that was had at the mini-reunion in Mount Pleasant, S.C. There were 35 classmates and 33 accompanying visitors, a very good turnout. We owe a great deal of appreciation to Jane and **Pete Quattrochi** who did such a fine job of making the local arrangements—the hotel, the tours to Boone Hall, Fort Moultrie, Patriot's Point, Fort Sumter, and the dinner cruise on "The Spirit of Charleston"—and all done with grace and friendliness. Nor should we forget my colleague, your co-secretary, **Louis Demarkles** and his wife, Jane. They did a super job of initial organizing, mailing, keeping track of who was going and of tending to all the many details that make these gatherings a success. One of the features of the affair was **Ed Eaton's** talk on giving for the 50th Reunion. We will be hearing more of this as the time for that event draws nearer.

After the reunion, **Stan Warsaw** set off for Australia to visit some relatives whom he hadn't seen for years.

That's all we have this month. Please write to let us know of your activities. We need your news to give vitality to this column.—Co-secretaries: **Andrew Corry**, P.O. Box 310, W. Hyannisport, MA 02672; **Louis Demarkles**, 77 Circuit Ave., Hyannis, MA 02601

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Please send news for this column to: **Clinton H. Springer**, secretary, P.O. Box 288, New Castle, NH 03854

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After a long dry spell, a veritable deluge of news came through after the 45th Reunion in early October. The first came from the reunion chair **Glen Dorflinger** just a few days after he got back to Houston. In addition to providing a list of some 35 alumni plus their wives, Glen wrote about the perfect weather at Kiawah Isle and the many ac-

tivities, from canoeing, swimming, tennis, and golf to sightseeing in and around charming Charleston. The fun and games began Friday evening with a poolside party at **Bob Spoerl's** spacious home on the island.

On Saturday night the bash was held at the inn, where the dinner and dance were helped along by a great band that (mercifully) played our familiar oldies from the '40s and '50s. There was also an entertaining "skit" written and directed by **Bob Hoffman** (singing around HMS Pinafore), with **George Ley**, **Bill Schield**, and **Bill Rapaport** wearing their seaman caps and telling of the past eight reunions led by chairs **Ted Heuchling**, **Stu Edgerly**, **Jim Craig**, **Ted Henning**, **Ned Tebbetts**, **Bob Spoerl**, **Jim Goldstein**, and **John Gunnarson**, from the 5th through the 40th in that order. The fun proceeded with numerous tales about funny pranks played in the Grad House and elsewhere. Among them was ex-roomy **Mario Vinci** (who had flown in from Irvine, Calif.—longest trip next to **Win Hayward** from San Francisco). Mario sent me a neat packet of photos he had taken of both the poolside party and the dinner dance, along with a tape cassette of their frolic at the inn. I think I recognized about half of the "company," including **Bob "Lemon" Wentsch** "pal"ing it up with Mario.

The program wrapped up Sunday morning with nomination of officers for the next five years. They include **Herb Oedel**, re-elected as treasurer, **Bob Hoffman** as chair of our 50th Reunion (a great, worthy choice!), and, in tradition, **Glen** as president (Bravo!). Oh yeah, and they said I could stay on as secretary. . . . And in case you're wondering, our 50th will be held the first weekend in June 1996 at the campus, with a possible side trip to someplace nearby.

Some other notes include one of **Bob Nelson's** tomes telling of 1990 trips far and wide—Switzerland and such—and 1991 trips to Ireland and "up coast" via AMTRAK to Seattle, and via rental car to Port Angeles, Vancouver, and Olympic National Park. He passes best wishes to the class, especially those who made it to Kiawah.

. . . One who *did* make it with his wife Mary was **Roy Bockhorst**, who came in from Godfrey, Ill. (we think), after slipping a note to the Alumni Association telling of his retirement from Olin Corp. last year and his basking in the leisure of all those things we retirees enjoy. Roy isn't pictured in the *Technique* or our "Bio Books," but is listed in the records as an "OE" oceanographer. Maybe he'll drop us a card and give us his birth date so I can include him on the birthday list I've compiled since mentioning it in the January *Tech Review*. Roy isn't alone in this respect. There are lots of missing names and numbers in the *Technique* I'd like to fill in. Another example is **E.H. "Ned" Bowman**, who graduated in management and is a Sloan School emeritus and is now teaching corporate management at U. Penn. Wharton School. Write us when you can, Ned.

The latest entry, which came in the mail as I was typing this, was a nice note from **Norm Sas**. It had to do with a trip he and his wife took last summer to the Canadian Rockies, bringing back memories of our trip there in 1947. The note included a wonderful set of photos showing scenes of Lake Louise and the Columbia Ice Field. Norm also clarified his family numbers, which I had guessed at a year ago. Norm has two daughters, one of whom has three sons, and one son not yet married! There, I think I have it straight! . . . Hope this finds you all in good straits!—**Jim Ray**, secretary, 2520 S. Ivanhoe Pl., Denver, CO 80222

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45th Reunion

A long and interesting letter recently from **Abbott Fletcher**—one of my old "housemates" from the Student House. Abbott retired from Bath Iron Works in Maine last April but continued with them as a consultant until completion of the highly successful Aegis prototype destroyer

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Arleigh Burke, DDG 51. Last July and August Abbott and five companions sailed the 44-foot sloop *Reindeer* up the west coast of Greenland, visiting the towns and spectacular inland waterways, the Jakobshavn glacier, Disco Island, and the U.S. Air Force base at Thule. There they were shown the control room of the large phased array surveillance radar. Pack ice blocked their passage northward to Etah so they retreated to Herbert Island and spent several delightful hours visiting with the 20 resident Inuit Indians. At Devon Island they saw two polar bears and musk ox. Pack ice (again) kept them out of Admiralty Inlet and caused a wide detour around to the east side of snow-covered Bylot Island into Pond Inlet. Pack ice again kept them 50 to 100 miles off Baffin Island; a near gale at the eastern end of Hudson Strait was uncomfortable to say the least. The mountains and inland passageways of Labrador were spectacular. The stark, treeless, barren, and cold landscape of the north gave way to the warm green lushness of Cape Breton Island before they returned to home base at Casco Bay, Maine.

Abbott is now back at Bath as a consultant until next summer. However, he has chartered a 49-foot sloop for five weeks in January and February to sail from Antigua to Granada and back to St. Martin. (Sounds like he's ready for warm climates after last year's trip!) Abbott is president of the MIT Club of Maine, holds a few miscellaneous directorships, and is involved in "a few other projects" in his spare time.

A brief note came from Roy Oberholtzer. He lives in Cedar Rapids, Iowa, where he retired last summer from Rockwell International. He says he's thoroughly enjoying his "mental freedom." This winter, he plans to start on his model railroad hobby, doing all of the design work on a PC.

Ann and I just returned from a delightful four weeks in Europe. We were in France, Switzerland, Italy, Germany, Holland, and Belgium—mostly driving on our own. We visited friends in the south of France and in Hamburg, and had a most interesting tour of Berlin, guided by our German friends. (I had lots of opportunity to practice my poor German!) We spent most nights in small country hotels, with only eight nights in the usual "tourist" hotels. Abbott, we also saw Labrador on the way back but it was from 35,000 feet up!—R.E. (Bob) McBride, secretary, 1511 E. Northcrest Dr., Highlands Ranch, CO 80126

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John Weil has a consulting practice in technology management. He is also on the board of some technology-based companies. John had been a VP of technology with Bendix; in 1984, when it was acquired by Allied, he was made vice-president. After he spent a year with Allied, he opted to leave rather than move from Bloomfield Hills, Mich., to Morristown, N.J. He considered forming a company in the biotechnology area, but decided to form the consulting practice.

John's family has been visiting the Colorado mountains since his childhood. He returns regularly for hiking and family gatherings at the same camp that he and his brothers attended as campers and as counselors. John continues to play tennis. His last contact with our class was at our 25th Reunion when he was living nearby in Weston. Brother, Tom, '51, has been a long-time employee of Raytheon as a senior scientist and lives in Wellesley. One of John's daughters is director of engineering for a biotech firm in the Cambridge area. John's other daughter is married and has one child with another on the way.

Jules Levin took an early retirement incentive and retired on October 1, 1991, from Sandia National Labs after a 37-year career there. He began his career in physics and electrical engineering; he later turned to computers and communications. He also did some video teleconferencing for the Departments of Energy and Defense.

He has been working around the house while

he plans what he will do next. His home is at 6,400 feet where there are extended periods of temperatures below freezing. While there is lots of sunshine, Jules thinks he is ready for warmer winters. A move is under consideration. Jules' wife died in 1987 and he remarried in 1990. Jules' son is curator of botany at the Natural History Museum in Balboa Park, San Diego. His daughter is with the transportation department of Dade County in Miami. Jules has many outdoor activities including hiking, bicycling, and jogging.

Bill Zimmerman and three associates bought the Huntington Sheraton in Pasadena after it was closed and sat idle on 20 acres of prime land. The hotel had an illustrious past, but risks of earthquake damage and a room layout based on guests bringing their own personal servants had dated the structure. Because some citizens wanted no changes, the proposals for reconstruction had to be approved in a city-wide election. Bill campaigned for his cause. The hotel reopened in March 1991 as the Ritz Carlton-Huntington. In November, the hotel received the grand award for the most beautiful landscaping project in Los Angeles and Orange County for 1991. If you need accommodations in the Pasadena area, the hotel is a lovely place to stay. Mention Bill's name for the friendly rate. Bill has been trying to figure out how to cut his activities back, but he enjoys the game too much to slow down. He sold one company, but still has 11. He is head of the Budget and Finance Committee of the board of trustees of Harvey Mudd College and is also on the board of the Museum of Natural History in Los Angeles. He plays tennis several times a week and is playing golf also. Bill and his wife, Eileen, have two grandchildren and a third is on the way.

Dave Cist retired from DuPont a while ago. As might be expected for someone with broad shoulders like Dave has, his responsibilities have continued. His son finished a PhD at MIT last summer, and his daughter came home to live while she makes a major transition in her life. Dave is also busy as a landlord for the property he owns on Cape Cod, and he rarely has a chance to use the property himself. . . . Dave Finnegan and his wife, Genie, swim every day. Dave is still active in Boy Scouts and responsible for Wood Badge training. He also leads an Explorer Post that is active in the theatrical performing arts. . . . Malcolm Reed sold his house in Reading, Mass., where he and his wife, Barbara, had lived since 1962. They bought land in Freedom, N.H., in 1984. An architect designed their dream house and gradually contractors completed construction. Malcolm did the landscaping himself. They have three children and three grandchildren.

Don Atwood, assistant secretary of defense since Bush took office, was in Moscow and Prague in November to discuss converting manufacturing facilities from military to civilian production. While in Moscow, President Gorbachev attended the meeting with Don. . . . Fiorenzo Losco is enjoying retirement in Voorhees, N.J. He plays golf, travels, reads, and plays with his grandchildren. . . . Ed Mack is working for Craig Adhesives in Newark, N.J., as an R&D chemist on hot melt adhesives, UV coatings, and solvent-based remountable adhesives. His wife, Elizabeth, and son, Edward, are residing in Wisconsin. Edward works in insurance for State Farm.

Bill Schmidt died in August. He and his wife, Marion, were living in Mansfield, Mass. On behalf of our classmates I extend our sympathy to Marion and her family. —Marty Billett, secretary and president, 16 Greenwood Ave., Barrington, RI 02806, (401) 245-8963

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By all reports, the mini-reunion organized by Marty Billett, president of the Class of 1948, was a huge success. Several couples told me they had

a "wonderful time." **Frank Hulswit**, assistant secretary for the Class of 1949, was there and provides the following report:

"On September 27, 28, and 29, 1991, the Classes of 1947, 1948, and 1949 held an interim Classes Reunion at The Harbor View Hotel, a 'majestic landmark hotel overlooking Edgartown harbor and Chappaquiddick, [which] offers elegant dining and gracious hospitality,' according to the *Best Read Guide to Martha's Vineyard*, and attested to by those of us who attended.

"There were 64 people at the Saturday night dinner-dance, and 50 attended the Saturday talk given by [MIT Economics Professor Robert] Solow, who vacations on the island and 'volunteered' to speak. The Class of 1949 was well-represented by 20 attendees: Dolly and **Harald Bjerke** all the way from Oslo, Norway; Betty and **Ira Dyer**; **Bob Griggs** from San Juan, Puerto Rico; Sonya and **Frank Hulswit**; Priscilla and **Davis Keniston** down from Perkinsville, Vt.; Jean and **Harry Lambe**; Pam and **Mickey Ligor**; Roz and **Stan Margolin**; Eunice and **Joe Schneider**; **Charles Sutherland**; and Doris and **Tom Weil** from Moreland Hills, Ohio.

"Although there were activities we could all enjoy, we also had plenty of time to pursue our own desires. Most of us found time to walk to downtown Edgartown for food and shopping. I even managed nine holes of golf.

"Most of the damage to the grounds of the hotel from Hurricane Bob had been eliminated. Edgartown also was neat and clean, but the woodlands on the island had many fallen trees. The hurricane winds had blown the leaves off almost all vegetation, but the leaves were regrowing, as were the spring flowers. In particular, the lilacs and apple blossoms were in full bloom, a most unusual and welcome sight for late September.

"We and the Bjerkes stayed at the hotel until Monday. Over cocktails and dinner, Harald and Dolly told us they were in America to help with 'Vinland Revisited,' an Icelandic/Norwegian venture that has built four ancient Viking ships (*Gaia*, an exact replica of the largest Viking ship found in Norway; the *Gokstad* longship, originally built in 850 AD; *Oseberg*, the most elegant of all known Viking ships, built in 800 AD; and *Saga Siglar*, a replica of a knarr, a Viking trader).

"From May 17 to October 9, the ships and their crews traveled from Bergen, Norway, to Washington, D.C., to commemorate Leif Ericson's journey from Greenland a thousand years ago and the Norse settlements in North America. In the New World, the ships dropped anchor in Newfoundland, Nova Scotia, Boston, Newport, and New York City before arriving in Washington, D.C., on October 9, Leif Ericson Day. The *Gaia* is to continue on to South America to carry a message of respect for our worldwide environment." (See *January*, page MIT 26.)

Frank G. Lane, M.D., passed away September 3, 1991, following a brief struggle with a rare cancer. The following is taken from a clipping reported from the town of Cornwall, Vt.

"He was born in St. Louis, Mo., on April 14, 1923. He graduated from MIT in 1949 with a degree in life sciences. In 1955, he received an MD from the University of Vermont College of Medicine. After an internship at Mount Auburn Hospital in Massachusetts, he pursued postgraduate work in human genetics and mathematics at the University of Michigan.

"In 1962 he returned to Vermont and taught mathematics and biology-teacher education at Middlebury College. In 1975 he returned to medicine and completed a psychiatric residency at the University of Vermont in 1979.

"Following the murder of his daughter, Nancy Lane, in 1985, he retired from psychiatry and pursued his interests in sculpting, gardening, and the propagation of walnut trees, along with other interests, from his home in Cornwall.

"Dr. Lane leaves his wife Barbara, a daughter Ellen and a son W.M. Steward Lane, both of Middlebury, Vt., three stepdaughters, Bethany O'Brien of Charlotte, Brenda Lienau of Bristol,

and Holly Myrick of Whiting, all in Vermont; a sister, Mary L. Kerwin, of Pensacola, Fla., and his former wife, Elizabeth Templeton, of Middlebury.

"Memorial contributions may be made to the American Cancer Society, 13 Loomis St., Montpelier, VT 05602.—**Fletcher Eaton**, secretary, 42 Perry Dr., Needham, MA 02192, (617) 449-1614

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The annual dinner of the 1950 Student Financial Aid Fund was held last October at the Faculty Club of the Institute. Forty-eight attended, including students who have been recipients of the Class of 50 Scholarship Fund, Class of 50 members and guests, and staff of the Alumni/ae Fund. Diana Strange, senior associate director of class and special programs, brought greetings from the Alumni/ae Association and congratulated the class on its receipt of the Presidential Citation.

For many years, our class banner has occupied a prominent position at our five-year reunions. However, the banner could not be located for our last reunion. If anyone knows of its location, please contact your class secretary.

Mariano "Nano" Romaguera reports that he now has six grandchildren, including the latest in Houston, Tex. Since he has two granddaughters in Orlando, he commutes to Florida at least twice each year from his home in Mayaguez, Puerto Rico. Another grandchild is expected in 1992. . . . **Joseph Oppenheim** is now attending the Florida Institute of Technology, taking courses in library research and death and dying (a psychology course). He plans to take additional courses to prepare himself for a full psychology program.

Hank Sharp for the past two years has entered the Boulder Mountain Tour, a 30-kilometer cross-country ski race held each year just north of Sun Valley, Idaho. In 1990 it took Hank 5 hours, 22 minutes to finish. This year his time was 3 hours, 53 minutes. *Great Improvement, Hank!* He reports that he waxed his skis and hurried. If anyone would like to compete and join him, the event is held each February. . . . **Samuel Tennant**, president of the Aerospace Corp., has been named a Jimmy Doolittle Fellow by the Aerospace Education Foundation of the Air Force Association. He has been president of Aerospace since 1987 and will retire in December 1991. Sam has been active in the field of orthopedic research and is the co-inventor of the Tavernetti-Tennant total knee prosthesis.

It is with sadness that we announce the deaths of our classmates, **William Martz**, of Winchester, Mass., in May 1990; **Douglas Porter**, Watertown, Mass., in June 1991; Professor **Kenneth Greider**, Davis, Calif., July 1990; **James Blackards, Jr.**, Mercer Island, Wash., June 1991; and **Douglas Martin**, Allentown, Pa., in August 1991. Our condolences to their friends and families.—**John T. McKenna**, secretary, P.O. Box 376, Cummaquid, MA 02637

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To initiate an innovative consultation service to meet the needs of food and packaging organizations, **Aaron L. Brody** a leading expert in food packaging, has been named managing director and partner of the firm Rubbright-Brody, Inc. He was the technologist in the development of microwave food heating and is the inventor of controlled atmosphere food preservation as well as one of the acclaimed aseptic packaging systems. He has authored six books and is on the faculty of Saint Joseph's University. . . . Following retirement as a professor at the University of Maryland, **Alan J. Faller** has moved to Melrose, Mass.

One sad note: on August 25, 1991, **Dellieware R. Nelson** passed away. A long time resident of Cambridge, Mass., he worked as a civil engineer for New England Concrete Pipe. We offer our condolences to his wife, Elsie.—**Martin N. Green-**

field, secretary, 25 Darrell Dr., Randolph, MA 02368

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40th Reunion

The last time I reported on **Donald Jaffe**, several errors made their way into the column; I hope we do better this time. Donald and his wife Carol have lived in Emmaus, Pa., for 26 years, raising five children, the youngest now in law school. After retiring from AT&T Bell Labs, two years ago he took a post as the deputy director of microelectronics packaging at Lehigh University. This may not be as industrial as it sounds; he is enjoying academia.

Our 40th Reunion will take place soon. Please come. In connection with this not-to-be-missed event, you may also have gotten the letter from Reunion Chairman **Bob Lurie** in which he requested current addresses of some classmates who have disappeared from the ken of the Alumni/ae Association. I happened to know that one of them, **Jim Vaughan**, had lived in the next town, Lost Altos, and finding a Jim Vaughan listed in the telephone directory, I soon was listening to a voice that seemed familiar even though I had not heard it for 39 years. In the course of a pleasant chat, Jim reeled off an imposing list of projects he had worked on for various organizations in the area over the years. I told him I was impressed by anyone who could make a living by consulting. Jim denied he made a living at it, leaving me more impressed than ever.—**Jim F. Lacey**, secretary, 2340 Cowper St., Palo Alto, CA 94301

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Please send news for this column to: **Gilbert "Gil" Gardner**, secretary, 1200 Trinity Dr., Alexandria, VA 22314, (703) 461-0331

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Please send news for this column to: **Edwin G. Eigel, Jr.**, secretary, 33 Pepperbush Ln., Fairfield, CT 06430

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Roger Reiss will be serving as chair for the Instrument Design Conference, a part of The International Society for Optical Engineering's 1992 International Symposium on Optical Applied Science and Engineering to be held in San Diego from July 19 to 24. Roger is employed by Lockheed Missiles & Space Co.

We understand that **Duwayne Peterson** has completed his relocation to San Marino, Calif. He also has been elected to the board of directors of Parallon Computer of Mountain View, Calif.—Co-secretaries: **Roy M. Salzman**, 481 Curve St., Carlisle, MA 01741; **James H. Eacker**, 3619 Folly Quarter Rd., Ellicott City, MD 21042

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On behalf of the Class I would like to thank **George Brattin** for a fine job as co-secretary for the past five years. . . . **Irwin Dorros**, executive vice-president, technical services, Bell Communications Research (Bellcore), Livingston, N.J., has received the Founders Medal "for distinguished technical leadership in the evolution of national telecommunications networks and the implementation of a major R&D resource." . . . Peter Cacaterria is project manager for development for the Mass Bay Transit Authority. He is celebrating the birthdays of his daughter (Janet Kathleen, 3) and his granddaughter, 1. . . . **Frank Amoroso** of Santa Ana, Calif., had an article published in the March-April issue of *International Journal of Satel-*

lite Communications and received a U.S. patent for inventing a "method and apparatus for achieving improved anti-jam performance via conversion gain."

We hold in remembrance **Richard Lee Unruh** who passed away July 26, 1991. Richard, a partner in the firm of Unruh/Moreland, practiced architecture in Eugene, Ore., for 25 years. He was a Fullbright scholar, pursued graduate studies at the Royal Academy of Fine Arts in Copenhagen, and was an assistant professor at the University of Oregon for six years. Richard is survived by his wife, Carole Unruh of Eugene, two daughters, a son, two sisters, and a grandson. Send news to: **Ralph A. Kohl**, cosecretary, 54 Bound Brook Rd., Newton, MA 02161

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Paul Carr received the Ralph I. Cole Engineer of the Year Award from the Rome Laboratory (formerly Rome Air Development Center). The award is for achievements in research, development, and management. Paul led the transition of his former "RF and SAW Components Branch" to the present "Components Technology Branch," which is now doing research and development on microwave integrated circuits, photonically triggered microwave switches, and high-temperature superconducting switches. He has also been a guest co-editor of the special issue of the *IEEE Transactions* on microwave theory and techniques.

Renata Cathou wrote some time ago that she was enjoying sailing on Chesapeake Bay with a much longer season than in Boston. The trade off is that she gets to support US Air and a car rental company and escapes the extra warm weather by taking off for Alaska when she can. . . . **Martha Goodway** has been the president of the Historical Metallurgical Society, which was founded in England in 1962 and publishes the journal *Historical Metallurgy*. She is the first woman and the first person from outside the United Kingdom to serve the society as its president.—**John T. Christian**, secretary, 23 Fredana Rd., Waban, MA 02168, (617) 589-2060

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We bring you somewhat belated greetings for the New Year. This month's mailbag was a bit sparse and contained both some bright and not-so-bright news. First, the bright side. **Martin Victor** writes, "I'm now in charge of DOD medical rescue for our astronauts. Also running the hospital at Patrick AFB. I continue to travel overseas and realized that I've gotten to see 51 countries and still counting! . . . **Larry Ogden** recently joined MicroAssays in Montpelier, Vt., as a principal engineer. He was previously with IBM's General Technology division in Essex Junction. . . . At the U.S. Masters Rowing Championships in Austin, Tex., this past September, I talked with **Pete Peterson**, who won a bunch of medals with the Cambridge Boat Club. This year, the club I rowed with finished out of the money, however.

We were saddened to learn that **Ron Newton** passed away last summer in California. He was the chief project engineer of the advanced launch systems program at Aerojet Techsystems, where he had worked for the past 29 years. Ron was very active with the Boy Scouts and church youth groups. Our sympathies go to his wife, Kathleen, and their three sons, Peter, Craig, and John. . . . In Baltimore, **Joel Klein**, who had retired after 25 years with the U.S. Army's Chemical R&D Center, also passed away last summer. He was teaching math and business at a local college and had an accounting practice as well. We extend our condolences to his wife, Annette, and their two children. Burial will be in Jerusalem where their daughter lives.

That is all for this month. Do something good for your conscience and send some news to your

lonesome secretary. Phone calls to (219) 264-4838 are welcome, and you can even leave news on the answering machine.—**Mike Brose**, secretary, 1619 Greenleaf Blvd., Elkhart, IN 46514

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The best way to start is to jump in and pick up the ball. A large mail bag has been accumulating so I'll dive right in with the most recent items.

The *New York Times* reported that fellow Course Iller **Paul Ekberg** has been named president and chief operating officer of Birmingham Steel, a NYSE-listed company. . . . Last year the *Times* also reported that **Kent Kresa** has been elected chair of Northrop Corp. having previously served as president. . . . We also heard from **Robert Brooker, Jr.**, president and chief operating officer of the Lord Corp., a manufacturer of anti-vibration devices and specialty chemicals; and from **Seymour Rubenstein**, who was appointed president and chief operating officer of Quality Systems Inc., a leading supplier of healthcare computer systems founded by **Sheldon Razen**, who currently serves as chair.

Accompanied with a photograph that seems to have been taken from the 1959 *Technique* was the announcement by Alleghany Power Service Corp. that **William Guyker, Jr.**, was appointed manager of research and development, a new position. Bill has been with Alleghany Power Service or its affiliated companies since graduation. How many other '59ers have been with one organization since graduation? . . . Continuing support from the class to the Alumni/ae Fund is indicated by notations on contribution slips. With thanks to all contributors, send in a note with your next check!

John Linderman, still maintaining his focus on intellectual property law in Connecticut, writes that he has been working with the MIT Enterprise Forum to assist emerging companies on their way to success. . . . Speaking of emerging companies and success, the recent initial public offering of Mitek Surgical boasts the names of founder **Arthur Collias** and venture capitalist **Barry Weinberg**. . . . **G. Richard Huguenin**, founder and CEO of Millitech, which produces and markets millimeter and submillimeter components and systems, has been serving as a trustee of the University of Massachusetts.

Robert Williamson is now the eastern sales manager for RadiSys of Beaverton, Ore. His leisure-activity focus is playing chamber and orchestra music with a rare Italian cello that Bob says makes anyone sound good. We may have a concert at the 35th, which is only 30 months away! . . . **Jack Fischer**, who spends much of his retirement time evaluating golf courses in Massachusetts, North Carolina, and Florida, is already preparing for the big gala. Jack and I recently met at the confirmation celebration for **Larry Bishoff's** daughter. Larry has an active consulting practice in the health services area with a special focus on small community hospitals and clinical practices. . . . Returning to the mail from the local scene, **Robert Broder** is VP of Monacelli Associates in Cambridge, a firm specializing in criminal justice facilities, particularly modular with fast track construction. . . . **Barry Altschul** has moved from a staff position after more than 20 years to line management at the Raytheon Equipment Division, where he heads a design group.

The academic mail starts with the news that **William Straughan** recently finished a PhD in civil engineering at Texas Tech! He wants to hear about anyone looking for a "young" new professor. . . . **Lawrence Wright** has moved from Williams College to be associate professor of computer science at North Adams State College. . . . **Daniel Wang**, (Chevron professor of chemical engineering at MIT, who also directs the MIT Biotechnology Process Engineering Center, was the Bioprocess Plenary Lecturer at the annual meeting of the ASME. . . . **Alan Oppenheim** has

been named distinguished professor of electrical engineering at MIT. . . . **David Garelick**, a professor of physics at Northeastern, keeps up with his five-times-weekly tennis practice, determined to win the U.S. Open for the 80 years and older group! David's wife Judith and I participated last year in a financial planning program for young alumni which was sponsored by the Alumni/ae Association.

Martin Gruber recently completed two years as chair of the finance department at the NYU Stern School of Business, where he has been teaching for more than 26 years. . . . **Charles Hill** assumed the chairmanship of the department of chemical engineering at the University of Wisconsin last year. He continues his research in enzyme technology, catalysis, ceramic membranes, and Raman spectroscopy. . . . **Allen Ream** announced his retirement from the Stanford faculty to pursue other interests in medicine and computers. He notes that the field of computer science will be well served as his three children are following that path.

It is also my duty to report on the deaths of our classmates. Our sympathies go to their families and friends. . . . I note the deaths of **Jason Seubold**, who, after completing graduate work at Cal Tech and USC, worked in the aerospace industry at Hughes, General Dynamics, and Lockheed; **James Hurley III**, who graduated in chemical engineering and had settled in southern California; **Robert H. Hansen**, who was employed for 32 years at Avon Products and retired as VP of administration last year; and the reverend **Frederick William Kelly**, who was manager of computer networks and systems at Fairfield University. Father Kelly had previously entered the priesthood before joining the class of 1959 and continued his work in Jesuit institutions in Iraq until 1970 before his move to Fairfield University. . . . **Surrendra Paul**, chair of the Apeejay-Surrendra Group in New Delhi and a leading industrialist in India, was assassinated last year. His daughter, Priti Paul, class of 1990, forwarded two newspaper articles that not only discussed his business career and his service on government boards but shared how most people will remember him for his radiance and joy.

You may recall that we have previously reported on the Class of 1959 Scholarship Fund, which was established in conjunction with our 25th Reunion. This fund provides scholarship support with a priority for sons and daughters of members of our class and then for the children of other alumni/ae of MIT. The most recent report from the Student Financial Aid Office indicated that there were six undergraduates who were receiving aid from our fund. We will prepare some profiles for all to share in future notes. This is an effort of which we can be proud.—**Allan S. Bufferd**, secretary, Office of the Treasurer, MIT, 238 Main St., Suite 200, Cambridge, MA 02142

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A recent edition of the *Wall Street Journal* notes that **Erik Ringkjøb** has assumed the position of assistant to the chairman of Storage Technology Corp. in Louisville, Colo. Erik was formerly president of Tuxen, Inc., in Denver. . . . From the *New York Times*, we find that **Paipen Der Torossian**, formerly president and CEO of Silicon Valley Group, Inc., in San Jose, Calif., has been named chairman of Silicon Valley Group.

A sad note from **Peter Belmont** reports the death of his wife, Sibyl, in July 1991. Peter lives in Lexington, Mass., and is compiling C and FORTRAN languages at Compass, Inc. Peter's son, Jeremy, is studying Chinese at UMass.

Finally, and on a personal note, classmates **Abe Reinberg**, **Bob Gurnitz**, **Jerry Kaiz**, and their wives joined in the wedding festivities for my son, David. It's always fun to get together with good friends, and this occasion was no exception. It's also a pleasure for your secretary to hear from classmates. Please write.—**Frank A. Tapparo**

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Gerry Wilson is on leave from MIT, where he once was a dean (engineering), but then retired to a graceful professorship. Now he is a corporate VP at Carrier Corp. in Syracuse.

Two letters this month. . . . Ellen Zarren, who isn't in our class but might as well be, wrote about **Bennett Zarren's** activities with other AEPIers. "The Class of '61 AEPI fraternity has done some major celebrating. In August 1990 **Clement Vaturi's** son Joel invited the class to sail from Nice to the Island of Corsica on the *Maxim des Mer* as a surprise for Clement's 50th birthday. Rachel and **Jiam Alcalay**, True and **Rob Fisher**, Sherri and **Jerry Goldman**, Brenda and **Ira Jaffe**, Linda and **Will Kenigsberg**, Phyllis and **Howie Rubin**, Georgianne and **Ken Singer**, **Mannie Judy Smith**, Joan and **Mike Wechsler**, and ourselves joined Clement and Joni's French friends and family for a memorable birthday.

"In August 1991 in Jerusalem, the Alcalaes, Jaffes, Vaturis, and Caren and Joan Wechsler celebrated the marriage of our daughter Phyllis to Tzion Zohar. Zohar was ordained a reform rabbi a week after the wedding and is continuing in a PhD program at New York University. Phyllis is a fifth-year graduate student at Hebrew Union College in New York City and will be ordained a reform rabbi in May 1992. Will there be another AEPI get-together? Stay tuned."

John Castle sent us a letter from Seattle, where he moved in August 1987 after selling his house in Boston at a considerable gain. In 1988 he and a partner started up a seed venture firm, Washington Biotechnology Funding. Things went fine until late 1989, when funding disappeared, and by September 1990 they were out of business. So John picked himself up and "reenergized" my consulting business and am advising several small technology companies on management, marketing, and product development. I recently completed a successful turnaround of a Seattle software company, which has expanded my experience beyond the chemical and biological sciences. Cynthia has been buffering the cycles of my career by working as an administrative assistant to Ernst & Young in Seattle. For the last two years we have lived on the 23rd floor of a new apartment building with panoramic views of the city, Puget Sound, Mt. Rainier, and the Olympic Mountains. Our guest room is ready and we invite our PMD friends to visit. Most of the other Castles have moved to Seattle, too. Daughter Leslie and her husband moved there in August. Son Michael came in April and is in school in Tacoma. Second daughter Lisa is in Vail, where she is in the catering business. Of the other Castles, Phil is studying biophysics at Johns Hopkins and David is a Ketchikan fisherman studying at the University of Alaska in Anchorage.

Thanks to both John and Ellen for their wonderful letters. Let them be models for us all.

I am writing in early November while packing for a trip to visit an uncle who has an olive farm in Tuscany, Italy. He needs help harvesting the olives, so I figured there were worse ways to spend a weeks vacation. While there I will think about the management troubles at my company and try to decide whether to import John Castle to Boston for some help.—**Andrew Braun**, secretary, 464 Heath St., Chestnut Hill, MA 02167

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30th Reunion

A bit short on items from our classmates this month, but with the 30th Reunion coming up June 4-7, we should have lots of news forthcoming in the 1992 columns. Sure hope you are planning to attend the reunion. We will have most of our class activities on campus this year. More on reunion plans as we get closer to the event.

Modesto A. (Mitch) Maidique writes that he was at the White House on January 16, 1991, when President Bush made the decision to order the green light on the Gulf War. Mitch was in Washington for a meeting of the President's Educational Policy Advisory Committee and met with President Bush, John Sununu, and Education Secretary-Designate Alexander just a few minutes after the President gave the Gulf War go order. Mitch gets last year's MIT Class of 1962 Witness To History Award.

The July 1991 issue of *Town and Country* carried a nice article on Bill Koch's effort to win the 1992 America's Cup. The article, "On Course for the Cup," featured a great two-page color spread of Bill at the wheel of his 85-foot racing maxi-yacht *Matador2*. There were many interesting anecdotes in the story, including, but not limited to, Bill's kayaking adventures on class-five rapids in New Zealand, his collection of fine wines, his design and construction of several racing yachts, and even his days at Culver Military Academy and MIT. It seems that naval fame runs in Bill's heritage. One of his ancestors, Capt. J. Lawrence, of the Chesapeake during the War of 1812, is memorialized by his dying words, "Don't Give Up the Ship!" We sincerely hope that Bill makes his mark in sailing circles by winning the America's Cup and not by famous last words from a sinking yacht.

I was puzzled by a sign on our Univ. of Alabama campus during the first week of October: "Celebrate Medical Records Week!" Our campus has a large medical school, but I still don't know if I was supposed to share the X-ray photographs of my latest broken leg with a friend or perhaps discuss the state of my internal disorders over cocktails in order to follow the directive of that banner. I guess I should be thankful that the message was a campus banner and not a memorandum from the university president. If any of you did "Celebrate Medical Records Week," I would love to hear about your meaningful experiences.

While in Louisville, Ky., to attend the annual meeting of the National Association of Economic Educators, Mary and I went to the Kentucky Museum of Science and Industry to see a film called "Beavers!" I suspect that most MIT graduates would appreciate the promotional poster that called it: "The Biggest Dam Movie You Ever Saw!" Even my brass rat wagged its tail. Please drop me a line when you get the chance.—**Hank McCarl**, secretary, P.O. Box 352, Birmingham, AL 35201-0352

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Please send news for this column to: **Phil Marcus**, secretary, 3410 Orange Grove Ct., Ellicott City, MD 21043, (301) 750-0184, CompuServe 72047,333, Internet: 72047.333@compuserve.com.

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As I write in late October, we are halfway between our 25th and 30th Reunions, it's not yet the end of the year when all good donors come to the aid of their school, we are in the midst of a lingering recession, and the almost-50 career stagnation phenomenon is at hand for some. Those must be among the reasons that my envelope from the Alumni/ae Association this month did not include a single news item, fund note, press release, clipping, or whatever. This column will be correspondingly short. . . . Things are going great for me, both personally and professionally, but the golf game stinks. That's it!

Please make those contributions to the Alumni/ae Fund and include your news notes. If you choose not to contribute, please communicate directly with me—to share your accomplishments and opinions and almost anything else with the rest of the class. Thanks.—**Joe Kasper**, secretary, RR 2, Box 4, Norwich, VT 05055

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I am pleased to report from a belated announcement, that **John Holdren** was elected to the National Academy of Sciences last April. John is a professor of energy and resources at the University of California, Berkeley. . . . Marie and I saw **Bruce Sunstein** and his son, Aaron, at the new Indian restaurant nearby. Aaron (age 4) was entertaining the clientele while Bruce was explaining the intricacies of Indian food. . . . **Chris Ebbe** writes that he is focused on obtaining accreditation units for his psychology internship program and that part of his travels in the accreditation wars "required" his travel to Hawaii last summer. . . . **Bill Brody** continues his entrepreneurial activities in radiology, remaining active as a member of the board of Diasonics.

The home front is certainly a lot quieter with both children grown and on the West Coast. Daughter Jeanne is in the Graduate School of Journalism at Berkeley and covered the Oakland fire for the *New York Daily News*. The continued pleasures of parenthood—her description of climbing the barbed wire fence (it wasn't too sharp) to get beyond the police lines in order to get into the middle of the raging inferno as a reporter. Sigh!—Write **George McKinney**, secretary, 33 Old Orchard Rd., Chestnut Hill, MA 02167, (617) 890-5771

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As I write this the leaves are falling off the trees . . . onto the snow. We fear that this year we may get a taste of the real Buffalo.

Stuart Shapiro stepped down as chair of the Department of Computer Science at SUNY Buffalo last year. He still teaches and is now the director of Graduate Studies. He was elected chair of the ACM SIGART and recently had a book published, *Common LISP—An Interactive Approach*. . . . Another author in the class of **Dennis Overbye**. He received a highly favorable notice in *Kirkus Reviews* for his *Lonely Hearts of the Cosmos: The Story of the Scientific Quest for the Secret of the Universe* published last year. . . . **Robert Lurie**, who has been VP of Managed Care Corp., is now also on the board of directors of Monitor Co., Inc., in Cambridge.

James Sweeney is a professor of Engineering-Economic Systems at Stanford University. He has just joined Charles River Associates as a senior consultant in the Energy Program. He has focused on questions of energy and environmental policy, particularly in the oil, natural gas, and electric utility industries. . . . **William Nelson** was running for an office in IEEE and sent along his biographical notes. He is at GTE Labs, where he is in the Optoelectronics Devices and Materials Department, working on semiconductor lasers and photonic integrated circuits. He is very active in the IEEE Lasers and Electro-Optics Society.

Many of our classmates are in the Washington, D.C., area. . . . **Arthur Boyars** has added leading a reliability engineering team to his duties as system engineer in hardware development for a Navy agency. He writes that his agency was on a list to have two-thirds of its people transferred or eliminated and adds that "uncertainty was fun only for Heisenberg." . . . **Dan Camerini-Otero** is chief of the Genetics and Biochemistry Branch of the National Institute of Health. He has been married for 22 years to Carol, whom he met at NYU Medical School. He has two children, Danny (11) and Sara (6), and has been at NIH since 1974. . . . Also in that area is **Kenneth Baxter**. He has spent 25 years with IBM, where he is currently an engineering manager at their Manassas, Va., Federal Systems location.

Another stable employee is **Edwin Meyer**, who has spent close to 25 years with LOTUS right in Cambridge. He is still with LOTUS but made a short move—to Munich, Germany. . . . Also on "foreign soil" is **Norman Rubin**. He is working

for Energy Probe Research Foundation, which has filed a lawsuit against the nuclear industry's legal safety net in Canada. After three years the case is finally entering discovery proceedings. Guess the courts move just as slowly in Canada as in the U.S. . . . Close to Canada is **David Vanderscoff**. He and wife Elaine are still enjoying the "big sky," fresh air, and green spaces in the upper Great Plain in Bismark, N.D. Their daughter Jessica is in medical school at the University of Minnesota and son Jason, 6'5", plays high school basketball. David was named one of the 200 best financial planners in the U.S. by *Money Magazine*.

From San Diego, **Franz Birkner** writes that he founded and is chair of ComStreat Corp., a supplier of satellite communications equipment. He spends his leisure time at his beach house in Leucadia, where visits from MIT friends are welcome (call 619-942-5100). . . . We should all visit **Donald York**, who is professor of astronomy and astrophysics at the Apache Point Observatory in Sunspot, N. Mex. It sounds like a wonderful place to spend the winter. He does have a full house, though, with wife Anna and four sons ranging in age from 10 to 20.

Microelectronics and Computer Technology Corp. (MCC) expanded the role of **COO Craig Fields**, giving him the additional title of CEO. MCC is a 54-member consortium that aims to develop an awareness of new business opportunities for its members—a variety of companies in the semi-conductor, telecom, computer, materials, defense, and aerospace industries. . . . **Patrick Lee** has received another award, the Oliver E. Buckley Condensed Matter Physics Prize, for his innovative contributions to the theory of electronic properties of solids, especially of strongly interacting and disordered materials.

Speaking of materials, every piece I had is now in order and in a file called "used." Do write!—**Eleanore Klepser**, secretary, 84 Northledge Dr., Snyder, NY 14226

67 25th Reunion

Our class has been responding enthusiastically to our 25th Reunion plans. At the time these class notes were written, well over 100 classmates had indicated they would attend the reunion, which will run from Thursday, June 4, through Sunday, June 7. Do attend. The 25th is special. . . you will have a good time among friends.

Harvey Golomb has joined Micro Dynamics, Ltd., in Silver Spring, Md., as its COO and a member of its board of directors. The company is a leading developer of document imaging and text retrieval products. Harvey was previously VP of marketing at Bitstream, Inc. He has extensive entrepreneurial experience, having founded Dataplace Computer Stores, Inc., a chain of retail stores in Phoenix, which he grew to be the largest Apple and IBM dealer in Arizona before selling it to BusinessLand. Harvey has an MBA from Harvard and has held positions at Harris and ITT Courier.

I received a very nice letter from **Marc Levenson**, who reminded me that I was the first person he met at MIT in 1963. Although Marc has kept a relatively low profile since graduation, a recent award requires a special report. Last September the Bay Area Chrome Users Society (BACUS) awarded Marc its 1991 BACUS/SPIE Prize for inventing the "Phase-Shifting Mask." The prize is awarded periodically to an individual or organization that has made a significant contribution to the advancement of photomask technology. The award was presented by Jim Reynolds, a leading techno-country singer and humorist, who led a humorous after-dinner show with outrageous lyrics to great classics. BACUS is the society of photomask technology, and masks are a key component of semiconductor manufacturing. Marc notes that the Japanese have developed the phase mask idea to the point where they are poised to use it for their next generation of chips; our country is more than three years behind, and

our mask makers and semiconductor industry are facing hard times as a result. Marc works at the IBM Almaden Research Center, lives in Saratoga, Calif., and hopes to attend our 25th Reunion. Following graduation from MIT, he received a PhD in physics from Stanford and taught at the University of Southern California and the University of Colorado. He joined IBM in 1979.

Steve Alter (PhD, '75), professor of information systems at the University of San Francisco, has finally completed his new introductory text, *Information Systems: A Management Perspective* (Addison-Wesley, 1992). The book views work practices as an integral part of information systems, and applies system and information concepts in presenting a usage-oriented coverage of the field. On leave this academic year, Steve is trying to extend the ideas in the book into a form of work-centered system analysis and design that is necessary for business process reengineering but is not adequately addressed by commonly discussed methods. In real life, Steve is enjoying living in San Francisco with his wife Carol Banquer (SM, '70) and daughter. Academia is not as interesting or intellectually stimulating as the business world, but leaves much more time for other priorities, such as playing chamber music.—**Jim Swanson**, secretary, 878 Hoffman Terrace, Los Altos, CA 94024

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Please send news for this column to: **Gail and Mike Marcus**, co-secretaries, 8026 Cypress Grove Ln., Cabin John, MD 20818

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David C. Hill writes that since January 1991 he has been president of the Fibers Division of Allied Signal in Morristown, N.J. The company manufactures nylon and polyester for carpet and industrial applications. . . . **Jeff Geier** is currently with Trimble Navigation Ltd., Sunnyvale, Calif. Jeff writes that he recently met **Tom Schonhoff** at an ION meeting and would like to hear from other Connor 5 people. "Number one son, Ian, a former decathlete at UC Santa Barbara, is pursuing marketing (\$). Number two son, Mark, is a football and baseball star in high school," writes Jeff.

That's all the notes from the outside, but I can't resist telling you that *Fire from Ice* was one of two books that John Wiley and Sons nominated this year for consideration by the Pulitzer Prize Committee. *The Soul of a New Machine* move over—I wish!—**Eugene F. Mallove**, secretary, 171 Woodhill-Hooksett Rd., Bow, NH 03304

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Professor **Steven Cushing** described his summer 1991 activities to us. As a member of the Boston Scottish Fiddle Club, he completed a concert tour of Nova Scotia in the summer of 1991, and a band that Steve organized took second place in the New England Regional Scottish Fiddling Championships. He also participated in an international conference on linguistics, logic, and music in Madrid, Spain, that was held to investigate the relationships among grammar, meter, and rhythm. Steve touches on these issues in his research at Boston University where he teaches language- and logic-related courses in computer science.

Sydney Jackson reports that in May 1991 he graduated from the San Francisco Theological Seminary with an MD (Master of Divinity). He was honored with the Alumnae Fellowship for further study and received the Martin Dwellé Kneeland Prize in Preaching. Sydney was ordained a Presbyterian minister on June 2, 1991, and can be found in Lebanon, Oreg., as the pastor of the First Presbyterian Church.

Wendell Brase has become vice-chancellor of Administrative and Business Services at the University of California, Irvine. In that position, Wendell controls an operating budget of \$58 million and directs almost 600 employees. He moved to this position from the University of California, Santa Cruz, where he was the vice-chancellor of Finance, Planning, and Administration.

For those of you who remember Halloween, if you happened to catch the right National Public Radio station, you would have heard the Proctor and Bergman show, the music for which was composed and performed by **Alan Chapman**.

Our class president has also moved on. **Steve Carhart** has become vice-president and director of publicly traded investments at Baker, Fentress & Co. in Chicago. For the previous five years, Steve had been a vice-president and senior portfolio manager at the Northern Trust Co. We are certain he would be pleased to receive all investment tips that members of the class wish to provide.

Please keep writing us so that we do not miss another issue as we did last month when the mailbox was empty.—**Greg and Karen Arenson**, secretaries, 125 W. 76th St., Apt. 2A, New York, NY 10023

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Sekazi K. Mtingwa of the U.S. Department of Energy's Argonne National Laboratory has been voted president-elect of the National Society of Black Physicists. He is a theoretical and experimental physicist in Argonne's high energy physics division where he is investigating "Wakefield" accelerators. He is a co-developer of the theory that describes scattering of partial beams in accelerators and is the co-author of 50 scientific publications. He holds doctoral and master's degrees in physics from Princeton and bachelor's degrees in physics and mathematics from MIT.

John Collier recently moved to Australia and is taking a lectureship in history and philosophy science at the University of Melbourne. . . . **Barbara Plantholt** is the president and CEO of Triad Investors Corp., a venture capital fund. Barbara was formerly a senior investment analyst for the Massachusetts Technology Corp. She has an SB in mathematics and Soviet studies from MIT and an SM in finance and management from the Sloan School.

Please send me your news.—**R. Hal Moorman**, secretary, P.O. Box 1808, Brenham, TX 77834-1808

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20th Reunion

Much news from the medical contingent this month. **Lenny Sigal** and his wife, Barbara, are the proud parents of a 19-month-old daughter, Merissa. Lenny now has tenure at UMDNJ-Robert Wood Johnson Medical School, where he is acting chief of the Division of Rheumatology and does research on "the real scourge of the '90s—Lyme disease."

Alfredo Sadun: "Recovering from a classic attack of middle-aged crises. I had set all my goals to be reached by age 40 (full professor, publishing a couple of books, house, kids). At age 39, I felt pretty good at having gotten there; at 40, I was faced with the 'where do we go from here?' crisis. Now I'm focusing on less concrete aspirations. My pleasures come from watching the growth of my department, my residents and fellows at work, and my kids at home. It was fun comparing notes with my former classmates at a Burton House reunion last summer in Chicago."

James Scott writes, "I'm working at Mass General Hospital where we are beginning some studies of cerebral metabolism in advanced meditative and 'altered' brain states. While exciting, I still wonder whether some of the strangest mental configurations weren't achieved during 18.02 lectures."

By now you should all have received informa-

tion about the upcoming 20th (now don't you feel old) reunion. As of this writing (early November, **Bonny Kellermann**, our reunion chairman, is overwhelmed—over 60 people have already signed up to come. So don't miss the social event of the year (June 5-7).

Bonny passed along these notes from recent trips to San Francisco and Washington: **Mark Hlatky** is a professor of physics at UC/Santa Cruz and also spends time working at the Stanford Linear Accelerator. . . . **Paul Hirsohn** is living in Berkeley and working at a Marin County software firm. He has contact prints of the last reunion and will, with luck, have them in true photo form for this reunion. . . . **Klaus Strelau** recently moved from Berkeley to Saratoga, Calif. and is working for Apple. . . . **Ken Okin** is living in Saratoga with his wife, Laura, and two kids. He works for Sun Computer.

On the East Coast, **Charlie Mann** is a consultant on energy in the Washington area, which has taken him frequently to Czechoslovakia. . . . **Kathy Swartz** has two kids, works for the Urban Institute, and lives in Bethesda. . . . **Ken Kampson** is a lawyer for the IRS and participates in a weekly hockey game. . . . **Becky Donellan** recently left the Justice Department, and **Paula Stone** has written a book on her personal experiences. Bonny wasn't sure she had all this exactly right and I'm not so sure I got it right from her, so you are all encouraged to write a good long letter with the real truth.—**Dick Fletcher**, co-secretary, 135 West St., Braintree, MA 02184

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Crystal Sloan writes "from a forest in the hills of eastern Tennessee," where she has just started a five-year project to modernize information flow and reduce middle-management expenses for a worldwide electronics firm. She notes that an improved radiation monitoring system for power plants, which she designed, is doing quite well. The "only full-time occupant of this forest," she is indulging her writing muse more, including some recently published music articles, a column on Compuserve, and many et ceteras. Crystal still finds time to manage Ephant Mujuru, the Zimbabwean mbira master, and imagining herself in an Afropop band. Her letter concludes with a graphic depiction of her first copperhead kill, which space prevents me from relaying. I just think she's having a bit more "life" in her life than many of us.

Chris Tavares was the subject of an article in a Shrewsbury, Mass., paper recently, entitled "Busy Rocket Man Keeps Club Flying." Chris is the new president of the Central Massachusetts Spacemodeling Society, and a nice tone to the article was provided by emphasizing his teaching new rocketeers the art and joy of his hobby.

A number of our class might enjoy this next item. Even before MIT, some half dozen (**Larry Dean**, **Dan Klein**, **Debra Judelson**, and two or three I can't recall) of us were in a National Science Foundation summer program in Chicago for two months in 1968. About two months ago, I was attending a meeting of a CD-ROM users conference in Reston, Va., when the next speaker was introduced as Art Crotzer, from a company in Oklahoma. Sure enough, he was one of the 50 from that program, and rather surprised to have been recognized 23 years down the road. Art passes a hello along to the MIT contingent (he attended Austin Peay in his native Tennessee).

That's about the size of it folks, so let's be sure to write!—**Robert M.O. Sutton, Sr.**, secretary, "Chapel Hill," 1302 Churchill Ct., Marshall, VA 22115

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Please send news for this column to: **Lionel Goulet**, secretary, 115 Albemarle Rd., Waltham, MA 02154-8133, (617) 899-9694

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Just two items this time: **Lawrence H. Summers** and his wife, Vicki, have 15-month-old (as of last October) twin girls, Pam and Ruth. He is currently on leave from the Harvard Economics Department, where he has taught since 1983, and is serving as chief economist of the World Bank in Washington, D.C. . . . I received a welcome note from **Sharon Gould Stewart**: "I am living in Madison, Wis., with my husband, John B. Anderson, '76 (physics), and sons, Jesse (15) (mine) and Sean (7) and David (4) (ours). John is a professor in the Meteorology Department, and I am making quilts, fixing up our vintage '60s house and landscaping with native plants and gardening." Sharon says she would love to hear from people—as would I! Keep writing.—**Jennifer Gordon**, secretary, c/o Pennie & Edmonds, 1155 Ave. of the Americas, New York, NY 10036

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Jeffrey Halis was quoted in the famous "Heard on the Street" column of the *Wall Street Journal* of October 21, 1991. Jeffrey is a general partner of Tyndall Partners, a hedge fund. . . . From **Pearl Huang**: "Finished my doctorate in molecular biology last year at Princeton. Now a senior scientist at Merk Sharp & Dohme at West Point, Pa., about 40 minutes north of Philadelphia. Married to Peter Hobbs, '76. We have two children, Helen (4), and Emmet (2). . . . **Mike McNamee**: "I'm working as an economics correspondent (reporter) in Washington for *Business Week*. My wife, 4-year-old son, and I live in Bethesda, Md., in a small colonial that we doubled in size last year. I've become a top-notch amateur wallpaper hanger and painter in the process. I'm also doing my duty for the Educational Council—I'm facing what looks like a record number of interested kids this year. So far, MIT has admitted the applicants whom I felt should be, so I must be doing something right!" . . . **Kenneth Davis, M.D.**, writes: "My pediatric practice, Elizabeth Pediatric Group, just opened a second office in Summit, N.J. We are expecting our third child in two months to add to Jack (4) and Eric (1)."

Miles Palmer: "Working with SDIO on strategic defense using electromagnetic railguns. Working on using guns to launch satellites into space." . . . **Allen Razdow** is chair and co-founder of MathSoft, Inc., producers of MathCad, the market leader in calculation software for engineers and scientists. MathSoft is in Kendall Square. Its software is used extensively in education." . . . **Diane Zingale** writes (on rice paper): "It's been seven years and I'm still here in Tokyo and plan to stay indefinitely. I've just started a new job as assistant vice-president, Technology Automation Group, Systems and Operations, for Citibank in Tokyo. I'm managing the data center here and really enjoying it. I'm still practicing aikido and sword at the Meiji Shrine dojo, and got my third black belt last year. Tokyo feels like home now."

As for your secretary, he continues to beard the giants of the data communications world. I enjoy a David vs. Goliath type contest. However, instead of being armed with a slingshot, I am going forth with aggressive pricing. I wonder how many ulcers I am helping to create or inflame? . . . Please write, fax or call.—**Arthur J. Carp**, secretary, Quantalytics, Inc., 220 Henley Rd., Woodmere, NY 11598-2523, (516) 295-3632, Fax: (516) 295-3230

As for your secretary, he continues to beard the giants of the data communications world. I enjoy a David vs. Goliath type contest. However, instead of being armed with a slingshot, I am going forth with aggressive pricing. I wonder how many ulcers I am helping to create or inflame? . . . Please write, fax or call.—**Arthur J. Carp**, secretary, Quantalytics, Inc., 220 Henley Rd., Woodmere, NY 11598-2523, (516) 295-3632, Fax: (516) 295-3230

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15th Reunion

It is my sad duty to report to you the death of **Robert "Bon" Foster** on September 12, 1991, after a year-long struggle with the AIDS virus. Bon was an attorney in Chicago and did a considerable amount of volunteer work. We extend our sympathy to his parents, family, and friends.

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We have a lot of other news this month, thanks in part to my generous offer of amnesty last year. A special thank you to all of you who took the time to share your news with us. It is always a delight for me to receive a letter from an old (or new!) friend and to pass that information along to the rest of you. So in a continued spirit of good will the offer of amnesty has been extended through Reunion Weekend, June 4-7. I hope to catch a glimpse, or more, of many of you there!

First, I must apologize to **Carlos Acevedo-Lucio**, who sent me a lovely note, for misplacing his letter and therefore having to report his comings and goings from memory. Carlos is still in Puerto Rico, remarried and working for Signal Trans-former. . . . I am delighted to report the births of sons to two dear friends, **Sam Gasser** and **Mike Di Novi**. Sam and his wife, Diane Waingrow, became the proud parents of their first child, David Nicholas Gasser, on July 12, 1991. Sam is employed at The Aerospace Corp. in El Segundo, Calif., working on remote sensing systems engineering, phenomenology, and data analysis. . . .

Michael and his wife, Beth Barnett, welcomed their first child, Julian Barnett Di Novi, on September 24, 1991. Beth is on the faculty at the Univ. of Maryland Medical School and Michael is still working for the FDA in Washington.

Richard G. Foote reports that he has begun a new job at DeLeuw, Cather & Co. in Boston as senior systems engineer for the integrated project control system for the Central Artery/Third Harbor Tunnel project. He lives in Lexington, Mass.

. . . Also in the Boston area, **Steve Bader** has been expanding his business and domestic enterprises with a growing dental practice in Peabody and a daughter, Natalie. . . . **Beth Ganister**, on the other hand, reports that "business is slow, but at least we are still in business given the current state of non-construction!" The rest of her life she characterizes as total (but enjoyable) bedlam with Lauren (4) and twins, Jackson and Julia (2).

Werner R. Haag is now director of chemistry at Purus, Inc. in San Jose, moving from a position at SRI International. . . . **Steven Field** has launched a new business venture, Workflow, Inc. They are a consulting firm, assisting businesses to become more profitable by improving the way they do work. . . . **Paul Ackman** has slowed down his travels enough to work for the family plumbing/heating/wholesale supply house in Richmond, Va. Paul reports that things have been quiet since his girlfriend, Jasmine, returned to Serbia, Yugoslavia last June. He was hoping she would be able to return to the States at this time. Paul saw Ellen Leverenz, '75, on a trip to San Francisco last year.

Barbara Belt let us know that she is in Houston working for Shell Oil. She sees fellow chemical engineers Jack Perini, '78, and Mark Dershowitz, '78, almost daily at the office. Her husband, Paul Erb, '76, works for Conoco. She assures us that they are still sailing! . . . **Richard Steinberg** has recently joined the faculty of Indiana Univ.-Purdue Univ. at Indianapolis as associate professor of economics. He also holds an appointment as adjunct associate professor of philanthropic studies for the Indiana Univ. Center on Philanthropy.

I had a nice conversation on the phone last night with **Jesse Abraham**. Jesse got married last year, and he and his wife, Amy, live in Arlington, Va. Jesse received a PhD in economics from Princeton after leaving MIT. After working for some time in the Boston area, Jesse moved to the D.C. area a couple of years ago to work for Freddie Mac. . . . **David Lu**, also in the Washington area, has been elected to Fellowship in the American College of Cardiology. He received his medical degree at Yale and is currently the director of the cardiac catheterization laboratory at the Washington Veterans Administration Medical Center.

I received a cheery note from **Alberto Sadun** who is living in Avondale Estates, Ga. He writes, "I have been very lucky in the last year or so, and many wonderful things have happened to me. I received tenure and have been promoted to

associate professor of astronomy here at Agnes Scott College. But, much more important is that I met a most wonderful woman to whom I am engaged. Erica Liebman is a PhD candidate in computer science at Georgia Tech. We intend to marry in May." . . . **Joel Freilich** recently returned to his home town of Cleveland, Ohio, to direct the Regional Transit Authority's Department of Strategic Planning and Research. He is accompanied by his wife, Louise, MCP '83, and their children, Samuel and Melissa. Joel welcomes your calls at (216) 566-5100.

The last bit of news comes from **Joe Egan**, who is living in northern Virginia. He is a partner at Shaw, Pittman, Potts and Trowbridge in Washington, D.C., where he practices nuclear regulatory, environmental, and public utilities law. He and his wife, Sheila, have a daughter, Jenny Rose (2). . . . Since this has been a column full of accomplishments, I would be remiss to not mention the recent success of my husband, **Paul Hertz**, in securing funding for a new x-ray astronomy instrument to be launched in September 1995. (Mark your calendars.) Paul will be part of the team at the Naval Research Lab in D.C. which will plan, build, and control the instrument. Now you may all rest your eyes until next issue. Or better yet, first drop me a line about your life, and then go take a long lunch break.—**Ninamarie Maragioglio**, secretary, 8459 Yellow Leaf Ct., Springfield, VA 22153-2522

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We have some breathtaking news from **Ely Dahan**: "My wife and I had quadruplets on Valentine's Day 1990. Sara, Daniel, Richard, and Robin are approaching the 'terrible twos' and are challenging all the laws of structural engineering I learned at MIT. In fact, most of the time they're not even 'civil'. Does MIT offer early admission to 2-year-olds?" Ely, wife, and their instant family are living in Owings Mills, Md.

Your class secretary and wife, Diane Curtis, are getting along with two kids, two golden retrievers, and (for now) two houses. Why not write or call and let us know what you're up to?—**Jim Bidigare**, secretary, 9095 North St. Rd., NW, Newark, OH 43055-9538, (614) 345-8582

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Meredith Warshaw dropped a line with the good news that she and husband, Mike Frankston, '71, are the proud parents of Keith Michael Warshaw Frankston, born last April. She writes, "He is a joy, and we're even getting some sleep! I'm trying to work from home, doing statistics for a psychiatry research group. Our days are punctuated by jackhammers, since we are building an addition so that Keith and I will no longer time-share my office." They reside in Lincoln, Mass. . . .

Chris Peterson wrote to announce another new arrival—this one is a book. "I just published my first book, *Unbounding the Future*, with my husband, Eric Drexler, '77. I'm also working as director of market operations for the American Information Exchange, a startup company in Palo Alto that is running an on-line open market for information and consulting. On the side, I organize conferences on molecular nanotechnology for the Foresight Institute." . . . **Troy Crites** is at the Aerospace Corp. where he just received a company-wide award, the President's Achievement Award. Troy is principal director of the Strategic Defense Initiative Architecture and received the award for "exceptional contributions to the SDI program through analysis and improvement of advanced defense architecture." Aerospace is a federally funded R&D center providing scientific, engineering, and technical support primarily to the U.S. Air Force.

How about the rest of you? There must be more good news out there.—**Sharon Lowenheim**, secretary, 98-30 67th Ave., Apt. 6E, Forest Hills, NY

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Kathy Sheffield will be working in internal medicine on temporary assignments in the south and southwest for the next year or more. She was in Phoenix, Ariz., from October to December. . . . **Sai Leong** is enjoying life in Houston with his wife Wendy and two children Deanna, 4, and Tiffany, 1. Sai doesn't say what kind of work he is doing in Houston; I hope he'll write to me with more details.

Donald Schmincke is president of Methods International, a strategic and organizational development firm specializing in implementing management and leadership processes. He previously worked at IBM as a senior executive consultant leading the development of their East coast programs.

Pearl Huang finished a doctorate in molecular biology at Princeton and is now a senior scientist at Merck, Sharp and Dohme in West Point, Pa., 40 minutes north of Philadelphia. She is married to Peter Hobbs, '76, and has two children Helen, 4, and Emmet, 2. Send your news to: **Kim Zaugg**, secretary, 2384 Leslie Circle, Ann Arbor, MI 48105, (313) 665-2365, vayda@erim.org.

81

I thought, when I moved from my old apartment to my new condo in Old Town Alexandria last June, that this would be my last move for at least a year or two, if for no other reason than it's such a pain in the neck to pack and unpack. The new place was pretty swanky, and seemed to be quite an improvement over the old one. Little did I know that within five months I'd be relocating to West Palm Beach, Fla.!

Now, it is not true that one of the prerequisites for the position of class secretary is residence in South Florida. The fact that my predecessor, **Lynn Radlauer Lubell**, lives less than 20 minutes south of here is purely coincidental. Nor is it true that I decided to move down here so that I could be on hand the next time Teddy Kennedy decides to party (despite my well-known admiration for the distinguished senator). The real story, in a nutshell, is that my law firm had decided to establish an intellectual property law practice in Florida. The firm had been looking for some time for one or more attorneys to relocate to our West Palm Beach office to get a patent group going. I was in a position to take advantage of the opportunity, being a member of the firm already, practicing in technologies (chemical and biotech) for which there was a particular need, and, yes, being relocatable (i.e., still single). It was too good to pass up. So now I'm back in an environment a bit more like my native Southern Cal, at least temperature-wise. I'm looking forward to a long and happy stay.

Enough about me now. Time for some real news. *Restore Your Technique*: For those of you who never got it at the Institute, for those of you who used to have it but lost it, and for any of you who have forgotten (intentionally or otherwise) just what you looked like as an MIT student, **Chuck Markham** has informed me that there are still a few extra *Technique* Yearbooks from 1981 that are available to class members for \$25. Please send your requests for the class yearbook, together with your remittance, to: Charles Markham, 85 Brainerd Rd., #610, Boston, MA 02134.

Bringing in the Sheaves: **Samir** and **Pamela Idriss** report from Hyde Park, Mass., that they are "serving the Lord daily by serving people, meeting the needs of our spiritual family, and actively teaching truths from the scriptures." The happy couple are preparing two home businesses as their permanent vocations. In particular, Pam is at home full-time with a wedding consulting business called "Cana Connection."

Putting it in Perspective: **Anita Bliss** notes from San Jose that she co-chaired an MIT Club of Northern California event, "The MIT Experience . . . A Woman's Perspective, with Bonny Kellermann,

'72," at the end of October. In her spare time, Anita is still working on her RC (radio-controlled) airplane, and hopes to make it fly soon.

That's a wrap for now. Any '81ers or friends thereof who happen to find themselves in the West Palm Beach area, feel free to stop by and say hi. I'll point out the way to Au Bar.—Mike Gerardi, secretary, 1515 S. Flagler Dr., #1204, West Palm Beach, FL 33401

82 10th Reunion

Plan on an exciting weekend in Boston, as we get together for our 10th Reunion June 4-7. The Reunion Committee is planning several events that are sure to draw an active crowd of '82s. MIT has general activities for all classes, including Tech Night at the Pops, the Technology Day program, and a Saturday barbecue featuring Alumni Games. Our class activities will include a Friday evening get-together on campus, a Saturday party at an exciting off-campus location, and a Sunday brunch at beautiful Endicott House in Dedham. I look forward to seeing many old and new friends that weekend. Watch your mail for further information!—Patrick Kinney, reunion chair, for Stephanie Pollack, secretary, 25 Royce Rd., Newton, MA 02159

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October brought the sound of wedding bells to our class, as two more classmates succumbed to nuptial bliss. On October 12, Julie Tiao married Tim Dann, SM '87, in Boston. The wedding was followed by a feast at Sally Ling's in Cambridge, the thought of which still makes me salivate. Julie changed into a very attractive traditional red dress for the remainder of the reception. Julie is the director of Hardware Development at BBN Communications in Cambridge, and Tim is vice-president of Greenwich Capital Markets. As for other attendees, here's the news. . . . Sarah Gavit, the maid of honor, works for Jet Propulsion Laboratory in Pasadena. Before that, Sarah worked for Martin Marietta in Colorado. . . . Dave Craigmile works for Anderson Consulting in Chicago. . . . Debbie Goldfarb works for Cadworks in the Bay Area. Katja Mamalakis, '84, and Mark Seidel live in Winchester, Mass. Mark is getting a PhD in electrical engineering at MIT, and he and Katja have been busy making babies (four at last count).

Tom Stepien is working for Novell in Silicon Valley and will be marrying Carolyn Rogers in February. . . . Terry Sutton Coonahan is working for DEC and is a track star on the side. Terry and her husband, Tim, have a 1-year-old daughter, Erin. Other attendees (who were not lucky enough to be in our class but still hip enough to be invited to the wedding) were: Rich and Crystal Schaaf, '82ers; Pam Gannon, Dave Douglas, Kathleen Harragan, and Bob Polutchko, '84ers; Joyce Chung, Bill Coleman, Diane "Muffy" Hess, and Elaine "Wu" Stephenson, '85ers; '86er Yichen Zhang; and Sloan grads Dan Isaacs, '86, and Stephen Siu, '87.

The very next day featured a wedding on the other coast, also attended by yours truly. Jeff Muss married his longtime girlfriend, Marilyn Bryant, bringing a long-awaited answer to the question, "In which decade would the ceremony take place?" Jeff met Marilyn while working on a master's at the University of Miami. He is currently earning a PhD at Berkeley in rocket science. Marilyn works for the city of Sacramento, as executive manager in transportation management. The wedding was held at the scenic Cliff House, overlooking the Pacific Ocean. Classmates in attendance were Ken Krugler, Brian Jacobs, Kristin (we still call her "Kinta" although no one else dares) Foss, Chris Schneider, and Randy Schweickart. Randy is living in Pearland, Tex., though I can't remember just what he is doing there. He did report to me that both Alex Petofi

and Steve Yoon were rumored to be alive, although I'm not really sure where. I would have paid more attention to the news of classmates, but I was too busy chowing down! Other MIT attendees were Mark Farley, '84, and Glenn Stump, '85, and a splendid time was had by all.

Here's some news from other classmates, just to prove that you don't have to feed me to get in the column. . . . Edward Hyman received an MS in biology at Stanford. He then attended medical school for a couple of years, leaving to start his own biotechnology company, Sybtel. Edward has four U.S. patents and one major publication describing two novel technologies. He has been awarded four research grants totaling \$200,000. Edward's research focus is on the development of an experimental immunotherapeutic treatment for leukemias and lymphomas. The treatment promises to stimulate the immune system of the patient to reject and destroy its own tumor cells. Clinical trials are expected to commence by the end of this year, and correspondence credit in 7.62 will be given to any classmates who claim to understand the above paragraph.

Melissa Miller Marin writes that she received an MBA from the Instituto de Estudios Superiores de la Empresa in Barcelona, Spain, in 1985. She then started in marketing with American Express's Latin America/Caribbean Headquarters. Melissa then transferred to Mexico City in 1985, and to Miami Lakes, Fla., where she currently holds the position of marketing director. Melissa is now responsible for all of American Express' marketing in Latin America and the Caribbean (42 countries in all).

Jim Willard writes that he recently took the position of VP for Technical Services with Wilshire Foam Products. Wilshire provides foam, rubber, and rigid plastic materials to the medical, electronics, and aerospace industries. Jim says the bulk of Wilshire's business is in the Southwest, but his negotiations of joint ventures in Singapore and Mexico are keeping him out of the California sun. You can reach Jim in Long Beach, Calif. (especially if you have any "special requests" for his products).

Jean-Joseph Cote writes that more and more of his time is occupied with orienteering. He races almost every weekend and spent this past summer traveling to most of the major competitions in Europe. Right now he is employed doing field survey work for a map (in a secret location) to be used for the 1993 World Orienteering Championships held in the U.S.A. I guess that part is not a secret.

Michael H. Abramsky has learned how to jot down his name and address, but has still not figured out how to write any news. Mike's living in Toronto. . . . Richard Norton is still at Eastman Kodak as are other alums, Mark Zaretsky, '80, John Border, '86, and Susan Visser, '86. . . . Ellen Kranzer is running a computer system at Harvard. It may seem like selling out, but someone has to help out those erudites up the river. Ellen says she still drops by MIT on a regular basis.

Thanks for writing. Keep 'em coming.—Jonathan Goldstein, secretary, TA Associates, 45 Milk St., Boston, MA 02109

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Suzanne Greene wrote to update us on that "infamous triple" from Burton 4: Betty Beitz and Tom Ransohoff are the proud parents of a baby boy, William Robert (aka Billy Bob), born in August. Chris Gosling and Mike Garrity '82 finally did it and were married in September at the MIT chapel. Robyn Coleman and Jeff Newell are currently abode sharing in Cupertino, Calif. And as for Suzanne, she finally found herself a non-MIT, non-IBMer, non-engineer, non-programmer, formerly non-Californian while on a Colorado ski vacation last winter. They plan to get married in New York in April or, if the stress of "wedding stuff" gets to onerous, elope to Tahoe.

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Michael Battat is at UC/Berkeley studying for an MBA. He was preceded by **Jesse Treger** who received his MBA in May. **Erik Gilbert** is also currently in the first year class. . . . **Richard Robbins** has graduated from the University of Chicago Law School and has taken a position in the Chicago area with the firm of Sidley and Austin. . . . **Mark Pundurs** is now an assistant professor of physics at Allegheny College in Pennsylvania.

Natalie Lorenz is still in the DC area and has bought a house in Beltsville, Md. She was promoted to senior associate at Booz, Allen and Hamilton. She spent six weeks in New Zealand and Australia on vacation last fall and saw some incredible sights and met friendly people wherever she stayed. . . . **Jonathon Goldman** is a principal civil engineer with SEACOR Environment Engineering and manager of their San Francisco office. He works for John Lambie, '83. Jonathon was recently appointed by the mayor to the city of Oakland, Calif., Waste Reduction and Recycling Commission. Jonathon also is working with Mary Breuer, '72, to expand the MIT Club of Northern California's consulting interest group.

I recently had the pleasure of attending the much heralded wedding of **Eric Alani** and **Esther Racoosin** in our nation's capitol (while the Thomas hearings were going full bore). Attending was a large MIT contingent: **Jeff and Ann Berner** and their amazingly cute (and well behaved) 1-year-old Christina. Jeff and Ann are back from nine months in Japan designing planes, teaching English, and eating sushi. . . . **Kim (Coldwell) Worley** and **Frank** have offered to expand their house for next year's New Year's party. Kim was in DC at the time for a genetics conference. . . . **Nancy, '87**, and **Vinny Natoli**: Vin has about two more years for a PhD in physics. Vin told me that **Malcolm Delaney** recently married his high school sweetheart, **Karen Friend**. Rounding out the MIT crowd were **Mark and Shelle Ensio**, **Chris Craven**, **Jeff Yoon**, **Andy Shooman**, '88, who is finishing a PhD at Brooklyn Poly, **Janet and Neil Kavesh**, and son **Mark**, **Marci and Wayne Greene** and daughter **Shoshana**, **Margot Pariser**, '85, and **Rockin' Dr.** Dangerous Dan Orange, '85. The happy couple honeymooned on Nantucket and are happily squared away in their Harvard Square (area) love nest.—**Howard Reubenstein**, (still recovering from New Year's in Vermont), secretary, 28 Mitchell Grant Way, Bedford, MA 01730, (617) 275-0213 (home), hbr@mitre.org

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News is sparse this month. We do have a few birth announcements. Last August, **Loren (Frost) Crawford** gave birth to a son, **Robert Richard**. Loren says that Bobby is keeping her quite busy during her leave of absence from PhD work in psychology at Cornell. She plans to return to her studies in spring 1992. . . . **Kathy (Geary) Balles** and **Eric Balles**, '80, have a new baby, **Josef Edwin**, born in September 1991. According to my calculations Josef and Bobby will be members of the MIT Class of 2013. . . . **Scott I. Chase**, fellow survivor of 18.021 and 18.022, married **Rhonda Beth Winston** in Tiburon, Calif., in a ceremony attended by **David Todd** and **Dan "The Man" Weidman**. . . . **Alan Foonberg** has been with Aerospace Corp. in El Segundo, Calif., for eight years, where he's currently working as a project engineer. Alan and his wife, **Lisa**, sold their first house and bought a new one in Manhattan Beach. . . . **India Starker** marked her second anniversary at Cognition last July. Cognition is "a small CAE company with very cool products," India writes. She invites all Mech E's designing things in Boston to visit her. Her number is (508) 667-7900 x119. India has been enjoying her Lighter recumbent, but would like to know how to make it faster. She and **Jim Puccio**, '78, have two new babies—baby cats, that is. . . . **David Hauser** recently accepted a contract position with Boeing in Seattle. He will be working with control systems

for the new 777 aircraft. (When are they going to get to the 800's?)

Jeffrey Bornstein completed his pediatric residency in June 1991 and plans to continue with a fellowship in pediatric endocrinology. Jeff's first child is due in March 1992. . . . **Paul Laibinis** completed a Ph.D. in chemistry at Harvard in June 1991, and finally made the inevitable move to California after ten years in Cambridge. Paul is a post-doctoral fellow in chemistry at Cal Tech and doing some of his research at JPL.

There was an MIT swim team reunion in November at Basta Pasta in San Francisco. Attending alumni swimmers were **Andy Renshaw**, **John Schmitz**, '83, **Bob Schoenlein**, '84, **Billy Gordon**, '87, **Topher Heigham**, '87, **Peter Neuhaus**, '89, **Laura Skolnik**, '89, and yours truly. Others attending were **Amy Austin**, '87, **Lynne Weinstein**, '87, and **Heather Smith**, Wellesley '84. Andy remains one step ahead of the AMA in his pathology residency in Boston. John still works at HP, and Topher is at Oracle. Bob is a researcher at Lawrence Berkeley Labs. Billy is an architecture graduate student at Berkeley, while Peter is across campus in the ME department. Laura is a researcher at Stanford. Oh, how I miss those 7 am 5,000 yard practices. Send news.—**Bill Messner**, secretary, 2234 Jefferson Ave., Berkeley, CA 94703, (510) 845-8119, internet: messner@cmls6.berkeley.edu

86

Greetings from Hermosa Beach! For those of you interested in what my husband looks like, check out the cover picture of the MIT section in the October '91 issue of *Technology Review*. Yep, that's Erik, the big ham. So I wrote a letter to the editor telling them the cover caption should have read "MIT Classes of '76, '81, '86 and Stanford Class of '85 do the Science Museum."

Doug Roth is now in his second year of surgical training at NYU Medical Center. His hours are very long but the work is very interesting. . . . **Scott Berkenblit** is still working on a PhD in the HST Medical Engineering/Medical Physics program. His project involves developing a new technology for diagnosing osteoarthritis at its earliest stages by exploiting the electromechanical transduction properties of cartilage (whew, I've been out of school too long). Anyway, Scott is living in a townhouse apartment with **Tim Shepard** in Edgerton House, MIT's newest grad dorm. . . . **Brian Mulcahey** graduated in June 1991 from the University of Chicago with an MBA in marketing. He now works in Concord, Mass., as a product marketing manager for GenRad, a high-tech manufacturer of automated software and test and measurement equipment. This summer, Brian took the trip he's always wanted: he rode his bike over 2,000 miles from Chicago to Rhode Island via Bar Harbor, Maine. It lasted 33 days and covered 10 states.

Well, that's all the news, so back to the alumni listing. Let's start with "H". . . . **Dr. Peter Haas** is at UMass/Amherst. . . . **Harold Haig** and **Patricia Haley** work for Cooper & Lybrand in Boston. . . . **Dr. Isabelle Haik** is at the University of Quebec at Montreal. . . . **Peter Halison** works for Nalco Europe Sarl in Sain Cloud, France. . . . **Gamal Hamid** works for Unity Bank in Omdurman, Sudan. . . . **William Hamm** is at Conoco in Houston. . . . **Patricia Hammer** is at the Transportation System Center in Cambridge, Mass. . . . **Joseph Hammer** is at Morgan Stanley in Tokyo. . . . And **Jean Hammond** is with Index Technology Corp.

Sang Hoon Han is at the Rocky Hill School in East Greenwich, R.I. . . . **David Handmaker** is with Bankers Trust Co. . . . **Brian Haney** is with Boston Edison Co. . . . **Denton Hanford** works for Boeing Aerospace in Seattle. . . . **Cynthia Hanna Kofford** is with Seagull Book & Tape in Salt Lake City. . . . **Christine Hao** works for DEC in Littleton, Mass. . . . **Dan Harasty** is with Bell Communications Research in Red Bank, N.J. . . .

Rohn Harmer is with Eastman Kodak in Rochester, N.Y. . . . **Bernard Harris** is at Scientific Generics in Waltham, Mass. . . . And **Patricia Harris** is with Interact Inc., in Acton, Mass.

Walter Harris works for Harrel Inc. in East Norwalk, Conn. . . . **Derek Harvey** is with Computations UK Ltd. in Surrey, England. . . . **Mary Harvey** works for Wang Labs in Lowell, Mass.

. . . **Shoichi Hashimoto** is with Mitsubishi Heavy Industries in Tokyo. . . . **Oscar Hauptman** is at Harvard Business School. . . . **Susan Havelka** is with Michael Fieldman & Partners, Architects and Planners, in New York City. . . . **Kenneth Hayes** is with United Airlines in San Francisco. . . .

Patricia Heffernan works for Neuron Corp. in Branford, Conn. . . . **Larry Heimann** is at Michigan State University. . . . **Richard Helling** is with Dow Chemical Co. in Pittsburgh, Calif. . . . **William Herian** is with Microsoft in Redmond, Wash. . . . **Glen Herman** is with Hughes Aircraft in Canoga Park, Calif. . . . **Shelly Herman** works for Financial Services Corp. in New York City.

. . . **Richard Herrmann** is with Chevron in Bakersfield, Calif. . . . **Jay Herther** is with Lockheed Sanders in Nashua, N.H. . . . **Sherri Hess** is at the University of Maryland. . . . **James Hexter** is at the Commonwealth of Mass., Public Facilities Planning Department in Boston. . . . **Capt. Jim Hibling** is at Wright Patterson Air Force Base in Dayton, Ohio.

Herve Hillion is with Serete Productions in Paris, France. . . . **Trevor Hine** is with Optical Sciences Centre in Canberra, Australia. . . .

David Hirsch is with Price Waterhouse in Menlo Park, Calif. . . . **Jon Hirschick** is with Premise Inc. in Cambridge, Mass. . . . **Beverly Hirtle** works for Federal Reserve Bank of New York, in New York City. . . . **Hiang Ho** is at the Nanyang Tech Institute School of MPE in Singapore. . . .

Michael Ho is at the University of Virginia Darden Graduate School of Business Administration. . . . **William Hobbis** is at Siemens Medical Systems in Hoffman Estates, Ill. . . . **Henry Hoeh** is with Grumman in Bethpage, N.Y. . . . **Kaleb Holen** works for Televerket in Helsingborg, Sweden. . . . **John Holmes** is with General Electric in Ann Arbor, Mich. . . . **Gordon Holtermann** is at Stanford Law School. . . . **Ryosuke Homma** is with Mitsubishi Corp. in Tokyo. . . .

Roy Hong works for First Boston Corp. in New York City. . . . **David Honig** is at UC Irvine. . . . **Donald Hooper** works for General Electric in Lynn, Mass. . . . **James Hopf** is at General Atomics Corp. in San Diego. . . . **Sheldon Horing** is with Cincinnati Bell Information Systems in Fairfax, Va. . . . **Irwin Horowitz** is at Cal Tech. . . .

Russell Howe-Smith is at General Electric in Cincinnati. . . . **Navy Lt. Jeffrey Hoyle** is aboard the USS *San Francisco*. . . . **Pai-Feng Hsu** is at Tufts Medical School. . . . **Paul Huang** is at the University of Tokyo. . . . **Seth Hulkower** is at Putnam Hayes & Bartlett Inc. in New York City.

Laurence Hungle is with Stull & Lee in Boston. . . . **Kim Hunter** is with BKT Enterprise Inc. in Hanover, Mass. . . . **Thanhthu Huynh** is at IBM in Austin. . . . **Keith Hylton** is at Northwestern Law School. . . . And **Benjamin Hyman** is with the Ministry of Interior, Planning Administration, in Jerusalem. . . . By this time, **Ellen Epstein** will have already had the big surprise party for **Karen Wohl** and **Ray Schmitt**. I will be lucky enough to be in the New York area to attend. More on this next time.

Thanks for the news.—**Mary C. Engebretth**, secretary, 1805 Manhattan Ave., Hermosa Beach, CA 90254, (310) 376-8094

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5th Reunion

Some classmates wrote in to the *Technology Review* Office with the following information. . . . **Ross Ortega** is living in Seattle and attending graduate school in the Computer Science Department at the University of Washington. . . . Congratulations to **Salvador Castillo** on his recent promotion to Air Force captain! Salvador is doing

research on electric propulsion devices for the Airforce at Phillips Lab, Edwards Air Force Base. . . . More congratulations, this time to **Mark Foringer** on his recent promotion to Air Force captain. Mike is at Cape Canaveral Air Force Station working as an engineer in the Titan IV Program. . . . Congratulations also to **John Penny** on his recent marriage to Catherine Kim, sister of John Kim ('87) and Chris Kim ('94)! **Paul Dawes** was the best man. Many fellow MIT Lambda Chi's from all over the country attended. After working in a patent law firm in Palo Alto, Calif., for six months, John has decided to go to law school. He will begin this fall at Santa Clara University.

And now, some information that came directly to me. . . . **John Athow** called all the way from Tacoma, Wash. John and **James Janosky** had each been on the USS *Reasoner* in the Persian Gulf and both have been out of the Navy since May. They came home to much excitement. John married Kathryn Fischer (University of Michigan) in May. Attending the wedding were **Sofia Merida**, **Jean Lee**, Mr. Athow (dad '47), James Janosky, Greg Brown, PhD, '90, Navy Lt. **David Easterby**, and Suzanne and James Person, '86. John and Kathryn then took a rock-climbing tour of North America. . . . James Janosky was married in August to Christine Lou (Wellesley, '89) in the Wellesley Chapel. Congratulations to both!

I was especially pleased to get a letter from **Wendy Gilman**, one of my freshman-year quads. "Charles and I have been married since August 1988 (hard to believe that much time has gone by). We've been living in Troy, N.Y., for two years, and we are now moving into our first house! It's very exciting. The house is a lot of work, although we will soon be experts at wall-paper removal! Meanwhile, in our spare time, Charles is employed as a research engineer at Rensselaer Polytechnic Institute and working toward a PhD in mechanical engineering. I'm working at a business consulting firm, doing statistical analysis, and also working part-time toward a master's degree in operations research and statistics at RPI. We don't do much else exciting—just occasional trips into Boston or to visit our families."

And thanks to **Todd Malone** for writing with his latest info. "After working for four years at Loral Aerospace, I decided to take off with my brother Scott for Southeast Asia. In three months we saw Thailand, Malaysia, Singapore, and Indonesia. During our visit in Singapore we stayed with **Tom Zirps**, who used to work there and came out for a vacation. He and I also spent a week in Bali. When my brother left to return home, I continued on for another month to explore Australia. When I got to Sydney, I stayed with **Arie-Willem VanDoorne**, who has been working there for years at Shell Australia.

"Since returning home, I have been looking for a new job and frequently seeing many of the dozen or so DU's in the area: **Tim Burks** ('86), **Paul Titterton** ('86), **Ed Martinage** ('86), **Tom Zirps**, **Corey Kerstetter**, **Tim Jones**, **Eric Gilbert** ('84), **Chris Masa** ('89), **Nabil Istafanous** ('89), **Aaron Warnock** ('88), **Paul Kegelmeyer** ('85), and **Garth Ghelbach** ('84).

"Anyway, I'm now planning to postpone the real job and work up at Lake Tahoe at a ski resort this winter (rough life, I know). If anyone wants to contact me, I can be reached at 130 Chula Vista Dr., San Rafael, CA 94901, (415) 457-0906."

Now, in case you were wondering, I'll tell you my latest news. I took a new job at the New York City Department of Sanitation. I'll be working as a senior analyst in the Bureau of Management Analysis. . . . One more plug for the New York Young Alumni/ae Group—more and more keep joining. Besides the "Thank It's Thursday Club," this winter there will be a holiday party and a Valentine's Day skating party! Call the NYC MIT Alumni/ae Club for details at (212) 983-9100.

Now it's your turn. Please call, write, FAX, or E-mail me and give me the scoop.—**Stephanie**

Levin, secretary, 159 West 80th St., Apt. 1D, New York, NY 10024, (212) 595-3172, FAX: (212) 983-9107, E-mail: mikki.mitvmc.mit.edu

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I hope everyone had a good holiday season. . . . **Stephanie Keenan** got married last year to a navy dentist, Lieutenant Commander Jim Keenan, who incidentally has the same last name as she! That must have made things very convenient! Those who attended the wedding include **Paula Blizard** and her husband David Brown, **Kimber Lynn Zinger**, and **Mary Lou Ravese**. Stephanie has been transferred to the USS *Manongahela*, an oiler currently in a Louisiana shipyard. She plans on grad school in Virginia next year, but says she misses Boston.

Frank Kulbaski graduated magna cum laude from Cornell Law School, where he was an articles editor for the *Law Review*. In September he began a clerkship with Judge Joyce Hens Green of the U.S. District Court for the District of Columbia. . . . **Andrew Keith** is working in the Advanced Design Department of Sikorsky Aircraft, working on new helicopter designs. He is married and living in Connecticut with one dog and two cats. . . . **Chris Cook** and his wife Kathy had their first child, Allison Therese, on July 24. They are looking forward to skiing in Maine this winter.

A little Alpha Tau Omega news. **Alan Gerstein** is reportedly living on the upper west side of Manhattan and working for JP Morgan. He finished an MBA at Sloan last year. A confidential source mentioned something about robbing the cradle (care to elaborate?), drinking beer, and watching the Jets. . . . **Jeff Szilagyi** is finishing Sloan and "still single and searching" (at the time of this writing, so I'm told).

For the second year in a row, *U.S. News and World Report* has ranked MIT as the nation's top school overall for graduate engineering education. The magazine said MIT had the nation's top graduate engineering programs in aerospace, chemical computer, electrical/electronic, materials/metallurgical, mechanical, and nuclear engineering. Second and third in line were Stanford University and the University of Illinois at Urbana-Champaign, respectively. Interestingly enough, Cal Tech came in fourth!

The New York Young Alumni Club had a reception at the United Nations to welcome President Charles Vest and the class of 1991. There was an excellent turnout and among those who attended were **Scott Lichtman**, **Christine Chu**, **Alan Gerstein**, and **Lisa Martin**. This organization is rather new and has many fun and exciting activities for alumni in the New York area. So if you live there and want to receive invites and flyers, make sure that MIT (not me) has your New York address.

The Alumni/ae Fund has benefited from generous donations from many '88ers. The qualifying annual members of the Great Dome Associates include **Christine Chu**, and **Barbara Sannwald**. Century Fund donors include **John Austin**, **Kendall Bryan**, **Blair Cohen**, **Elliot Douglas**, **Anthony Giordano**, **Kennedy Johnson**, **Andrew Keith**, **John Kohl**, **Jon Lundberg**, **James Meehan**, **Marek Niczporuk**, **Ernest Prabhakar**, **Lawrence Rosen**, **Abdon Ruiz**, **John Seo**, **John Snyder**, and **Ken Yu**. Good job guys!

Jun Sochi is attending Columbia Graduate School. . . . **Andrea Wong** is attending Stanford Business School. . . . If you haven't seen familiar names in this column for a while, how about writing and telling the rest of us what your friends are up to.—**Grace Ma**, secretary, 545 1st Ave., #7R, New York, NY 10016, (212) 447-1925

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I received a nice letter from **Krista (Beed) Pas-trone**, who reports that she is happily married to

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Craig Pastrone, '90. Krista worked for Boeing Helicopters for a year, and then she and Craig moved to Albuquerque, N.Mex., where Craig is now working for Intel. Krista is also happy to report that she and Craig are expecting a baby at the end of March! So, as Krista says, "I've stopped looking for an engineering job—I figure being a mom will be plenty challenging for now!"

Krista also passes along a lot of news about other classmates. **Michele Sequeira** is also in Albuquerque, working for Ethicon, Inc. Michele lives with Mike Westfall, '90, who is working at Intel. . . . **Jennifer Felch** lives in the Seattle area, working for Parametric Technology Corp. as an applications engineer. Her area of service includes Washington, Oregon, Montana, British Columbia, and Alaska. Jennifer is engaged to her longtime beau, Andy Price. . . . **Sophia Wang** is still in Palo Alto, Calif., and is working for Lockheed, but she is ready to move on to another job or maybe grad school. . . . **Ed Kim** is still in New York, but is desperately trying to get out. Although Prudential-Bache is happy to keep him, Ed is actively looking for another job outside of NYC.

Amy Austria is still working for Cambridge Technology Group but is wondering what kind of work would allow her to use her creative, artistic skills. She is still seeing Kapo Karagozain, '87. . . . **Nancy Kim** also works at CTG and has had the chance to travel for work. She seems to really enjoy it. . . . **Maya Bose** studies chiropractics in Chicago; she is currently spending some time in India. . . . **Eileen Murphy** is in medical school. She and her husband John Zink, '88, have bought a house. . . . **Beth Green** is married to Byron Shaw, '90. . . . **Alison Miyamoto** is doing very well on her way to a PhD in biology at Stanford.

Catherine Rocchio went to the wedding of **Karen Gold** and Tim Lash, '87, this past July; she reports that it was a beautiful wedding. "MIT alums were there in full force. **Jen Felch** and **Carolyn Zehner** were bridesmaids. Other classmates attending were **Maya Bose**, **Amy Austria**, and **Jeff Applebaum** (who looked great and seems to love working in California). Catherine recently had dinner with Karen and Tim at their house in Arlington and says that "they are doing lots of work on the house and it all looks great so far!" Karen is working in software (her boss is Don Woodlock, '88), but is ready for a change.

Catherine saw **Anthony Lombardo** and his new wife Kristy this past summer. They were married this past June. Anthony is in an MD/PhD program in Alabama. Catherine writes that she "became engaged on September 9 to Sean Garrett, '88. I am still working at BBN and coaching the MIT Women's Gymnastics Team—and loving it; they are a wonderful group of women."

Chris Maeda is still in grad school and reports that he is "a big time UNIX weenie these days." . . . **David Kwon** is working at Teradyne in southern California. David has recently earned a Red Belt in Tae Kwon Do. . . . **Paul Sajda** has started his third year of study in the PhD program in bioengineering at the University of Pennsylvania. Paul has just received the Department of Defense Science and Engineering Fellowship. Paul, his wife Angela, **Mike Petro**, and Sue Powers, W '90, recently made a trip down to Walt Disney World. Paul also attended the wedding of **Boris Zemelman**. Also present were **Van Pham**, **Ethan Joffe**, Micah Alder, '90; Dave Blundin, '88; and Craig Cohen, '88.

Salik Malik is in Pakistan. . . . **Mark Lillibridge** is in grad school at Carnegie Mellon, where he is working toward a PhD in computer science. . . . After finishing the Leaders for Manufacturing Program with master's degrees in materials engineering and management, **Julia Putnam** took a two month vacation to Fiji, New Zealand, and Australia before beginning her career as a senior engineer at Johnson and Johnson's Ethicon, Inc. in Cincinnati, Ohio. Julia is helping to design and develop medical devices for laparoscopic surgery. These "closed proce-

dures" greatly decrease post-operative pain and recovery time.

Barry Margulies and Mary-Elizabeth Harmon, '90, write from the lab of Dr. Wade Gibson at Johns Hopkins Medical School. Mary is in her second year, and Barry is in his third having recently passed his graduate board orals. Both are PhD students who are studying human herpesvirus V, affectionately called cytomegalovirus. . . . **Chris Carone** is at Harvard working on a PhD in particle physics. Chris received a master's degree this past June, and Chris reports that "my PhD research continues to go well." . . . **Ron Koo** has just received his appointment as an Educational Counselor for the coming year. (Call the admissions office to find out more about being an EC.) Ron will get to chat with applicants to MIT and then evaluate them.

Thanks to everyone who wrote this month, especially Kristal—**Henry Houh**, secretary, 4 Ames St., Cambridge, MA 02142-1306, (617) 225-6680, e-mail: tripleh@athena.mit.edu or henry-houh@mit.edu

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Shawn Williams is in her second year at UCLA Law School, where she is a member of the UCLA Law Review. She spent the summer working at Hughes Aircraft Co. in the Patents and Licensing Division of the Legal Department. Shawn writes that **Lynore Taylor** is working on a master's degree in electrical engineering at the University of Virginia. Also, Lynore recently got engaged to Nat Young, '89. . . . Some other news from Shawn: **Robert Dodd** is at Stanford in the MD/PhD program. . . . **Shelly Dixon** is working for Delco in southern California. . . . **Jason Vickers** is in his second year at Michigan Law School. . . . **Cindy Estrella** is working for Hughes Aircraft Co. in Los Angeles, and **Mary Harmon** is at Johns Hopkins working on a PhD in biology.

Last summer, **M.M. (Tamal) Islam** traveled to Europe with his high school friends. Tamal is currently working at Westinghouse, mainly doing instrumentation work to help stabilize nuclear waste tanks. In the spring, at MIT, Tamal met up with **Mike Charney**. Mike is working for an architecture firm in New York. . . . **Elena Koutras** also traveled to Europe over the summer. She spent two weeks sightseeing around France. She writes that she saw a lot of Paris and Nice. She even met up with Yusef Butt, '89, in Nice for a day! Work at The Harris Group has been very busy for Elena, but she says that she really loves her job! She's now in the Engineering Management Department of the Engineering Division. Elena does a lot of consulting on facility acquisition program management. In her spare time (she rarely finds any), Elena has met up with **Todd Shauger**, **Mountaga Aw**, **Ariel Warszawski**, **Mark Stammering**, and Reid Prouty, '88.

Jennifer Jankowski is an associate consultant at Legacy Technology, Inc., in Woburn, Mass. Jennifer is working on Legacy's downsizing and reengineering projects. . . . **Thomas Sacoman** is working at Chrysler Corp. in Detroit, Mich. He received a master's degree in mechanical engineering from MIT last year. . . . And finally, at the recent MIT Alumni Leadership Conference in Boston, I ran into **Mini Gupta**, **Meryl Alford**, **Humphrey Chen**, and **Joe Babiec**. . . . Let's see some more news next time! Please send mail to **Ning Peng**, secretary, 355 South End Ave., Apt. 27G, New York, NY 10280, (212) 745-2704

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Well, now that we've left MIT, it appears that the MBTA B-line may be a new gathering place for our classmates. Just this morning, **Poorti Srivastava** and I rode the same train down Commonwealth Avenue toward Boston. Poorti works for Charles River Associates and lives in a house with her brother and other MIT alumni/ae. One

evening a few weeks ago, **Seth Gordon** and I saw one another while riding the B-line home. . . .

Of course, most classmates have ventured further from Cambridge than the outer reaches of Commonwealth Avenue. **Angela Roberts** visited friends in Argentina before moving to San Francisco to begin working for Oracle. . . . **Dai Matsui** works for Industrial Bank of Japan in Tokyo and would like to keep in touch with any classmates who are in Japan. You'll find Dai at 2-18-19 Kamishoshigaya, Setagaya-ku, Tokyo 157. . . .

Michael Gojer is now in Austin, Tex., attending the University of Texas for medical school. . . .

Wendy Muhlenkamp is working at Lord Corp. in Erie, Pa., in the rotary wing design section of their aerospace division. . . . **Chuck Benson** studies at the Indiana University Medical School.

Mike Mitchell is in Rochester, Minn., working for IBM. . . . **Catherine Crawford** and **Dmitry Yakobson** are both studying at Princeton. . . .

Michael Goodwin and **Jeff Kuo** are currently working at Bell Labs. . . . **Adam Schwartz** works for a securities firm in Chicago. **Kris Slanine** is finishing up a master's degree at Digital in Colorado. . . .

Mark Walker is in the Department of Political Science at UC/Berkeley, **Leora Goren** is in their architecture program, and **Jean Ihm** is at Berkeley for law school.

Of course, there are those who persevere at 77 Massachusetts Avenue. **John Kim** is at MIT studying electrical engineering. . . . **Keith Swartz** is studying with the experimental music studio in the media lab. . . . **Jason Silver** now lives in the new graduate dorm. . . . Others at MIT include **Paul Kan**, **Laura Adams**, **Dan Schmidt**, and **William Gorgen**. But I'll bet there are plenty more! Please write to let us know what's happening on campus.

Elsewhere in and around Boston, you'll find **David Borison** working for Andersen Consulting and living in Somerville. . . . **Ann Rogers** is at the University of Massachusetts Medical School. . . . **Sarah Park** studies medicine while **Jane Williamson**, **Pete Stewart**, and I study law at Boston University.

Jane brings news from several classmates. She reports that **Laura Mayfield** is spending a year in Japan and that **Sue Perrin** begins work in November for Schlumberger in Italy. . . . **Jeanne Druding** is working in Wichita for Air Products. Jeanne's two kittens are named Bonnie and Clyde. **Cynthia Madras** works for Raytheon in Lexington.

Vijay Balasubramanian is finishing a master's at Xerox in Palo Alto. . . . **Amy Thorsen** is studying medicine at New York University. . . . **Scott Davie** and **Michael Caren** are among several MIT classmates who study mechanical engineering at Stanford. . . . **Zach Ambrose** is working in Newport, R.I., as an ensign in the U.S. Navy. . . .

Leticia Soto will be in Chicago for a year or two before considering graduate school. . . . **Lance Jackson** is at Washington University studying medicine. . . . **Ned Eisner** studies plasma physics at Columbia. . . . **Lama Rimawi** is at Harvard Medical School. . . . **Tanya Halvorsen** is in the MD/PhD program at UC/San Diego.

Sharra Davidson is working on George Bush's re-election campaign. She recently attended the pair of well-publicized dinners in Houston and Indianapolis for Bush and Quayle. She sends news about many classmates: "Yvonne Barrera is working down in Dallas, Tex. This summer, she saw **Annamarie Wong**, who is now in medical school in Florida. Yvonne has also seen **Neyda Gutierrez** who is also in Texas. . . . **Orlando Martinez** is also down there working for a chemical engineering firm." . . . **Sharra** writes that **Tom Brady** is working for a small engineering firm in Las Vegas and that **Kacey Dalton** is working for an architectural firm in Oklahoma. . . . **Sharra** is joined in Washington, D.C., by **Julie Foss**, **Sue Ruffo**, and **Brigitte Pak**.

Thanks for the news! I look forward to hearing from the rest of you very soon!—**Andrew Strehle**, secretary, 12 Commonwealth Ct., #10, Brighton, MA 02135, (617) 232-2261

I CIVIL ENGINEERING

Joseph J. Rixner, SM '67, CE '68, writes: "I am managing partner of H&A of New York, a 50-person consulting, geotechnical, and environmental engineering firm located in Rochester, N.Y. H&A is an affiliate of Haley & Aldrich, Inc., of Cambridge. . . . **Erik Vanmarcke**, PhD '70, reports: "I was appointed to an endowed visiting professorship at Stanford University this past summer, where I worked on earthquake engineering. I then resumed working in the Department of Civil Engineering and Operations Research at Princeton University, where I have been for the last six years. Prior to this I was an MIT Course I professor from 1970 to 1985." . . . **John P. Dugan, Jr.**, SM '68, sends word: "I am the manager of the Glastonbury, Conn., office of Haley & Aldrich, Inc., Geotechnical Engineers and Environmental Consultants. This year I am serving as president of Connecticut Engineers in Private Practice, a member organization of the American Consulting Engineers Council, which represents consulting engineers in Connecticut."

Kathy Ayan, SM '85, writes: "I've left my job as a geotechnical engineer with GEI Consultants in Winchester, Mass., and have moved down to Charlottesville, Va. I'm pursuing an MBA at the Darden School of the University of Virginia and anticipate graduating in May of 1993." . . . From Albany, N.Y., **Joel Brainard**, SM '67, writes: "My wife, Jane Carol, and I started a middle school (grades 4-8) this year along with a few other parents who felt it would be easier and better than trying to change the local public school bureaucracy. In our spare time we continue to work full time at our regular jobs: I as chief of regulatory research at the New York State Department of Public Service and Jane Carol as a lawyer for the New York State Department of Law. Stress levels continue to exceed our wildest expectations."

Eric F. Peyrard, SM '82, reports: "I'm still at IBM France to the surprise of most of my fellow MIT classmates. (They never thought that I'd have enough white shirts...but Brooks Brothers ships to France...). I keep in touch with Course I alumni in the States (**Steve P. Gordon**, SM '82, **Charlie T. Daneil**, SM '82, etc.), in France (**E. Des Moutis**, SM '81 (XIII), **Patrick Jalliet**, SM '81, PhD '85, etc.), and with **Jonathan Richmond**, SM '81 (XI), PhD '91, wherever he is (Australia to Alaska). I'm also in charge of the jobs service of the MIT Club of Paris." . . . **Harry N. Wallin**, SM '37, sends word from San Mateo, Calif.: "Having been retired from the U.S. Navy (since 1968) and Bechtel Corp. (since 1978), I keep busy traveling (with my wife of 50 years), playing golf and doing charity work for the Society of American Military Engineers and participating in activities of the Navy League and the American Society of Civil Engineers."

Norman W. Llewellyn, SM '49, writes: "I retired from my position as chair and CEO of the Lane Construction Corp. in Meriden, Conn., heavy and highway general contractors, after 40 years of employment. I plan to stay in Farmington, Conn., with winters on Kiawah Island, S.C. . . . **Jose Bermudez-Marcos**, SM '85, reports: "I am working as an industry consultant in Andersen Consulting's Madrid office. I enjoy applying my

skills to solve business problems in different companies." . . . From Ramsey, N.J., **Richard S. Ladd**, SM '66, writes: "I have been nominated to serve as chair of ASTM's Committee D18 on Soil and Rock for 1992-93. I am also serving a three-year term on ASTM's Committee on Standards."

Kevin Phillips, SM '73, ENE '73, sends word from Northport, N.Y.: "I am a principal of Fanning, Phillips, and Molnar. We began our twelfth year with a total of 40 people specializing in hazardous waste management, groundwater modeling, environmental engineering, and civil engineering. We have completed projects in almost all of the eastern seaboard states and we've been awarded an EPA ARC contract for ground- and surface-water modeling." . . . From West Caldwell, N.J., **Michael Bruno**, ScD '86, reports: "I am now in my third year as director of Davidson Laboratory at Stevens Institute of Technology. 1991 has been particularly busy, with trips to Norway, Korea, and in December, Argentina, for an NSF-sponsored workshop on coastal resources utilization."

Dennis Fay, SM '71, has been appointed executive director of the Alameda County Congestion Management Agency. . . . From Bogota, Colombia, **Gustavo A. Jaramillo-Rego**, SM '69, CE '74, sends a note with his Alumni Fund contribution: "This small donation keeps no proportion with the great appreciation that I keep from my times at MIT. This sum is only symbolic, although it is more than a great proportion of what most Colombians earn in a month." . . . **Anthony O. Lee**, SM '87, PhD '90, sends word from Irving, Tex.: "I'm enjoying life after MIT working for American Airlines Decision Technologies. The benefits are great! I've been flying all over the country!" . . . **Joseph C. Nadeau**, SM '91, is pursuing a PhD in the Civil Engineering Department at the University of California at Berkeley. . . . **Willard M. Snyder**, SM '48, and **Richard H. McCuen** have published *Numerical Analysis with Sliding Polynomials*. Snyder is the developer of sliding polynomials, an alternative to spline functions. . . . **Kenneth R. Maser**, SM '67, PhD '71, writes: "I left my position with the CE department to take on a full-time role as president of Infrasense, a company that supplies high-tech highway speed survey services for the inspection of pavements and bridge decks."

Joseph Burns, SM '81, reports: "I returned to Chicago at the beginning of this year from two years with Skidmore, Owings & Merrill in their London office. In July, I joined LeMessurier Consultants, Inc., of Cambridge, to open their Chicago office to serve Midwest clients. I also began teaching structures as an adjunct assistant professor at the School of Architecture at the University of Illinois at Chicago. . . . **Arthur N.L. Chiu**, SM '53, professor of civil engineering at the University of Hawaii at Manoa, has been elected to the grade of Honorary Member of the American Society of Civil Engineers. Chiu was cited for "extensive contributions to research advancing knowledge of wind effects on structures, as well as his work to promote bilateral cooperative research projects between the U.S. and Asia." Election to the grade is considered one of the highest forms of civil engineering peer recognition available to a member; only one out of every 7,500 ASCE members is elevated to this grade in his or her lifetime.

II MECHANICAL ENGINEERING

Major **Michael R. Helmick**, SM '88, sends word: "Since graduating from MIT, I have completed a three-year assignment as instructor, assistant professor, and finally associate professor and executive officer in the Department of Civil and Mechanical Engineering at the U.S. Military Academy at West Point. While teaching thermodynamics and heat transfer there, I assisted with the renewal of the accreditation of our engineering programs by the Accreditation Board for Engineering and Technology (A.B.E.T.). I was promoted to major in the U.S. Army in September 1991 and now attend the U.S. Army Command and General Staff College at Fort Leavenworth, Kans. My wife and I had our first child, Stephanie, in February 1990, while at West Point." . . . **Sadik Kakac**, SM '59, professor and chair of mechanical engineering at the University of Miami, has been elected a Fellow of ASME.

From London, **John Stopford**, SM '62, writes: "My latest book, *Rival States: Rival Firms*, was published by Cambridge University Press last October. In this work, written jointly with Susan Strange, we attempt to build bridges between international relations and business to show how nations now compete for shares of world wealth." . . . **Jon A. Andresen**, SM '73, president of Technology Solutions, has just moved his firm to a larger facility to handle expanding business. The firm specializes in bar-code education, consulting, and systems integration work in the San Francisco Bay area. . . . **C. Thomas Avedisian**, SM '74, associate professor in the Department of Mechanical and Aerospace Engineering at Cornell University, has been elected a Fellow of ASME. Avedisian "has made important contributions in the field of droplets and bubbles that occur in such situations as a microgravity environment and phase transitions of highly superheated liquids," according to the ASME News.

The Alumni/ae Association has been notified that **Watson E. Slabaugh**, SM '30, of Mansfield, Ohio, died after a long illness on August 31, 1991. There was no further information provided.

III MATERIALS SCIENCE AND ENGINEERING

From Washington, D.C., **Don Ritter**, SM '63, ScD '66, writes: "Just a brief update from your alum in the Congress: A report I requested from the General Accounting Office on the effects of formal Quality Management programs at U.S. companies has become the GAO's all-time best-seller. 'Management Practices: U.S. Companies Improve Performance through Quality Efforts,' was released on June 3, and GAO has already distributed more than 31,000 copies. I recently became the ranking Republican on the House Energy and Commerce Committee's Subcommittee on Transportation and Hazardous Materials, and ranking Republican on the Science, Space, and Technology Committee's Subcommittee on Environment. From these posts, I seek to influence the debate over putting technological risks into a rational perspective. I am deeply engaged in reauthorizing the nation's solid

waste disposal law, the Resource Conservation and Recovery Act; and in persuading Americans to take a closer look at the soundness of the science in the global warming debate. I have received the American Society of Metals Distinguished Life Membership Award, the Institute of Electrical and Electronics Engineers' IEEE United States Board Award for Distinguished Public Service, and the American Association of Engineering Societies Chairman's Award. . . . From Brookline, Mass., **Ernst B. Weglein**, SM '58, MTE '59, writes: "I am now enjoying the practice of law as much as I enjoyed the practice of engineering for 24 years."

Edmund H. Moore, SM '87, reports: "Presently, I am employed and a graduate student in the Department of Materials Science and Engineering at the University of Florida in Gainesville. I hope to graduate with a doctorate in this area by August of 1992. My specialized area is polymer science, but I am working in the areas of ceramics and polymers (utilizing microwave energy to process materials). Finally, I am employed as an engineer in the Palace Knight Program (Air Force), at Wright-Patterson Air Force Base in Ohio. Upon graduation, I hope to move to Ohio and work at the Materials Laboratory at Wright-Patterson. I have received another master's degree in materials science and engineering from the University of Florida in 1989." . . . **Steve Gedeon**, SM '84, PhD '87, writes: "I left my job at the U.S. Army Materials Technology Lab in 1988 and spent two years living in Venice, Italy, working for Nuova Samim/Temau (the corporate research labs of Italy's largest materials producer). In 1990 I moved to Toronto, Canada, to become director of research and technology at the Welding Institute of Canada. I am adjunct faculty at both the University of Toronto and University of Waterloo." . . . **David Cranmer**, SM '78, PhD '81, sends word from Brookeville, Md.: "I am a U.S. Department of Commerce, Science, & Technology Fellow at the White House Office of Science & Technology Policy. After the fellowship ends in June 1992, I will return to the Ceramics Division at the National Institute of Standards and Technology, where I am leader of the Mechanical Properties Group." . . . **Henry Inouye**, SM '52, has been retired since 1985.

Robert D. Williams, SM '37, of Lake Helen, Fla., died on September 17, 1991. He worked for the Battelle Memorial Institute from 1942 until his retirement in 1976. He was a member of the American Institute of Mining and Metallurgical Engineering, the American Society of Metallurgy, and the Ohio Society of Professional Engineers. He was also an avid sailor and belonged to the Leather Lips Sailing Club in Delaware, Ohio. . . . **Aubert L. "Jack" Mowry**, SM '48, of Northridge, Calif., died on March 16, 1991 of amyloidosis, a metabolic disease. Mowry retired from engineering in 1987. There was no further information provided.

IV ARCHITECTURE

Joseph Burns, SM '81, reports: "I returned to Chicago at the beginning of this year from two years with Skidmore, Owings & Merrill in their London office. In July, I joined LeMessurier Consultants, Inc., of Cambridge, to open their Chicago office to serve Midwest clients. I also began teaching structures as an adjunct assistant professor at the School of Architecture at the University of Illinois at Chicago." . . . **Robert L. Ziegelman**, MAR '59, writes: "I was just awarded commissions to design the physics building at the University of Michigan and the American Concrete Institute's corporate headquarters. I'm working on prefabricated housing, schools, and hospital proposals for Kuwait and Israel. Initial concepts developed while I was at MIT and actual

buildings constructed throughout the U.S., Mexico, Guatemala, and Canada." . . . **Peter C. Sugar**, MAR '60, sends word: "Early this year (1991) I joined SAR Engineering, Inc., as their director of operations. SAR is a multi-disciplinary building services engineering consulting firm, with nearly 60 employees, located in Quincy, Mass." . . . **Robert H. Dietz**, MAR '44, writes: "I retired from the University of Washington's Department of Architecture & Urban Planning in 1975 where I was past dean and professor. I am now living in Allyn, Wash., and Borrego Springs, Calif. I sketch, play golf, read, and keep up with current events and architecture. I occasionally write **Lawrence B. Anderson**, MAR '30, my professor at MIT."

From Salem, Ore., **Floyd M. Jennings**, MCP '44, writes: "Since the time when I served as the first director of the N.D. State Planning Commission, the Garrison Dam has been constructed, east-west highways built, and many irrigation projects now in operation. However, the business districts of the cities and towns show marked deterioration. More than 200 photos were taken, and I wrote a 60-page account of my five-week visit to the 'Land of my Fathers.'" . . . **Astra Zarina**, MAR '55, reports: "I am professor of architecture and director of the University of Washington in Rome Center. I am also an architect and consultant to the University of Washington for the design and restoration of the UW Rome center which occupies the Palazzo Pio, a 17th century palace. This palace was constructed over the ruins of the Teatro Pompeo (55 B.C.) and overlooks the Campo de Fiori. I am the founder and director of the UW Italian Hilltowns Program and the Architecture in Rome Program, which are now both in their 22nd year. I participated in the First Nordic Baltic Architectural Triennial in Tallinn in the fall of 1990. I delivered two lectures to the Union of Latvian Architects and the University of Riga Latvia, entitled 'Experience and Projects in America and Europe' and 'Teaching Young Americans in Italy.'" . . . In Muncie, Ind., **J. Robert Taylor**, MAR '65, has been president of Taylor Architects, Inc., since 1985 and professor of architecture at Ball State University since 1967. . . . **Annie C. Harris**, MAR '73, is executive director of The Salem Partnership in Salem, Mass. Previously, she was a VP for The Langelier Co., Inc., in Boston.

Charles A. Lawrence, Jr., MAR '39, of Seattle, Wash., died on July 12, 1991. He was a member of AIA and a partner in the firm of Lawrence and Hazen architects. There was no further information provided. **C. Gregory Bassett, Jr.**, MCP '48, of Hilton Head Island, S.C., died on September 25, 1991. Bassett served in the 406th Infantry in Europe during World War II. He joined the National Capital Planning Commission in 1967 as director of urban renewal and housing and later became director of urban capital improvement programming; he had previously served as director of the community renewal project for Baltimore, and worked with the Philadelphia Planning Commission during the early redevelopment of the city's center area. During his planning career he also taught at several universities, and served as director of the Greater Bridgeport (Conn.) Regional Planning Commission.

V CHEMISTRY

Raymond Vritis, PhD '90, writes: "I accepted a position as senior research scientist at Air Products & Chemicals Co. I am currently working for Schumacher, a wholly owned subsidiary located in Carlsbad, Calif." . . . **Moungi G. Bawendi**, an MIT Course V assistant professor, has been awarded a five-year fellowship by the David and Lucile Packard Foundation. Each of the 20 recipients will receive 100,000 per year to support their

scientific research—the nation's largest program of unrestricted grants to young university faculty in science and engineering. Bawendi's research includes the study of electronic properties of nanometer size semiconductor crystallites. The Foundation was created in 1964 to support and encourage organizations dependent on private funding and volunteer leadership. . . . The Thomas A. Spencer Endowed Undergraduate Research Opportunities has been established at MIT by **K. Barry Sharpless**, Course V professor, in honor of his mentor at Dartmouth College.

David G. Edwards, PhD '42, of Pacific Grove, Calif., died on December 29, 1990. He was a chemical engineer for several companies for 24 years before working for 20 years as director of mental health for San Benito County. In 1983, he was named Social Worker of the Year for the Central Coast region of the National Association of Social Workers.

VI ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

From Huntsville, Ala., **Albert A. Mullin**, SM '57, writes: "I am following up on my 'Puzzle Corner' problem in *Technology Review's* February/March 1989 issue. I'm investigating properties of complex semantical objects named after an important MIT graduate, the late R.P. Feynman. I define a 'Feynman object' to be a sentence, formula, verse, interaction, or relation that is false forwards and valid backwards. Connections are made with several interactions traceable to the CPT theorem. The definition is motivated by Feynman's own words: 'People often think I'm a faker, but I'm usually honest, in a certain way—in such a way that often nobody believes me!'" . . . **Edwin Z. Gabriel**, '51, sends word from Ocean Grove, N.J.: "I received a U.S. Patent last December on a cargo-hook device with automatic snatching and releasing capability. Kessler Sales Corp. of Fremont, Ohio, is trying to find a manufacturer for the device. I will apply for another patent shortly on a cargo and personnel lifting apparatus with automatic loading and unloading features. Apparatus may be self-propelled or hoisted from a helicopter." . . . **James M. Tien**, SM '67, EE '70, PhD '72, chair of the Department of Decision Sciences and Engineering Systems at Rensselaer Polytechnic Institute, was elected a Fellow of the IEEE. . . . **Andrew Yagle**, SM '81, EE '82, PhD '85, writes: "I have received tenure as an associate professor in the Department of Electrical Engineering and Computer Science at the University of Michigan in Ann Arbor."

From McLean, Va., Captain **Steven N. Anastasion**, SM '48, writes: "I was elected an honorary member of the Hungarian Academy of Engineering." . . . **Nathaniel J. Fisch**, '72, SM '75,



PhD '78, has been appointed director of Graduate Studies for Plasma Physics and director of the Program in Plasma Physics in the Department of Astrophysical Sciences at Princeton University. Fisch holds positions of professor in the Department of Astrophysical Sciences and principal research scientist at Princeton Plasma Physics

N.J. Fisch

Laboratory. He joined PPPL in 1978 and is best known for his suggestion that lower-hybrid and other waves can be used to generate continuously, and at low cost, the toroidal current in a tokamak plasma and for his theoretical calculations of the conductivity and other fundamental quantities associated with an externally heated plasma. . . .

Curtis D. Brown, SM '70, of Ogden, Utah, is senior VP of Iomega Corp., makers of the Bernoulli Box.

From Sun River, Ore., **Wilbur B. Davenport, Jr.**, SM '43, ScD '50, of Sun River, Ore., reports: "I saw the Marconi Memorial Monument at Poldhu in Cornwall, England, for the first time recently. Quite something for this retired communications engineering professor."... **Benjamin H. Ciscel**, SM '47, send word from Round Rock, Tex.: "I'm still hale and hearty at 76 years. We own and manage income property, which provides both exercise and excitement. I have been writing novels for the past six years, but with no interest from a publisher. We have a daughter, Stephanie, attending the University of Texas mixing art and architecture."... From Muskegon, Mich., **Wesley W. Pendleton**, SM '40, writes: "We are 'hard' at work trying to keep healthy. We limit fats, cholesterol, sodium, red meats, junk food, alcohol, and caffeine. We try to eat green leafy vegs, squash, yams, etc. We keep on with the vitamins even though it is best to get them by foods. We hit the bran cereals (oat and wheat) each morning. We drink lots of water, fruit drinks, and skim milk. Fruit appears in at least two meals each day. Finally, we exercise every day, bring a good sweat out by walking fast and long (three miles a day)."

Walter Hamscher, SM '83, PhD '88, sends word from Half Moon Bay, Calif.: "I'm working at the Price Waterhouse Technology Centre, a computer science research facility with activities in artificial intelligence and hypertext. I am managing a research project involving the use of model-based reasoning techniques for the analysis of internal controls on accounting systems."... **Adolfo Guzman-Arenas**, SM '67, PhD '69, writes: "I am now VP for engineering at International Software Systems, Inc., a software company in Austin, Tex., that builds software tools for augmenting the productivity of the programs such as CASE tools and rapid prototyping systems. My background in artificial intelligence comes in handy for this."... **Jay M. Prager**, SM '70, is a senior VP for Vicor Corp. Previously he was VP for Systems Engineering at the Andover, Mass.-based firm....

Lois W. Bowles, of Wellesley, Mass., wife of the late **Edward L. Bowles**, SM '22, a radar pioneer and MIT professor emeritus, died June 4, 1991. Along with her husband, she donated an education center to the Newton-Wellesley Hospital, as well as a plaza to Washington University in St. Louis.

VI-A INTERNSHIP PROGRAM

The deaths of two Institute faculty have saddened us, as I write this in October 1991. Professor **Margaret L.A. MacVicar**, '64 (VIII), ScD '67 (III), Dean for Undergraduate Education, died on September 30, 1991, after a year's bout with cancer. She was widely known for her establishment of the Undergraduate Research Opportunities Program (UROP) at MIT. The other death, on October 24, 1991, by a stroke, is that of **Richard H. Frazier**, '23, SM '32, professor emeritus of electromagnetics in the EECS Department. Dick was 91 and was a very personal friend of mine, having known him since the time I joined MIT in 1956. Some of you associated with him the Instrumentation Laboratory (later divested as the C.S. Draper Lab) may have completed graduate theses under his guidance, as he acted as the Department's Graduate Office liaison with that facility. He was a charter member, in 1923, of MIT's Massachusetts Beta Chapter of the engineering honor society, Tau Beta Pi—along with his classmate, **Julius A. Stratton**, '23, SM '26. Incidentally, I'm in my 36th year as a member of that Chapter's advisory board.

A VI-A'er who's back at the Institute this academic year is **Elwyn R. Berlekamp**, '62, SM '62, PhD '64, a visiting professor in the EECS

Department. He is on leave from the University of California at Berkeley.... VI-A Director, **Kevin J. O'Toole**, SM '57, NE '57 (XIII), was invited to attend the 1991 Annual Fall Meeting of the Biomedical Engineering Society at the University of Virginia, Charlottesville, in mid-October, to deliver a talk on academic/industrial relations, entitled "A Model for Academic and Industrial Cooperation," using the VI-A Internship Program's 75 years as an example!

From the VI-A alums who've either visited or called we've gathered the following information: **Steven L. Bates**, '74, SM '76, EE '76, says things are going well with his new affiliation with Tau-Tron, Inc., in Westford, Mass.... **Michael L. Bushnell**, '75, who is on the Rutgers University faculty, was on campus to give a talk to Course I on his system computer work, stopped by for a short "hello" and told us he is a recipient of a Presidential Young Investigator Award and had received a PhD.... **Dean R. Collins**, '58, SM '59, stopped by to see Director O'Toole and me during a campus visit on behalf of TI, Inc., and PhD recruiting.... **James L. Fenton**, '78, SM '79, with Watkins-Johnson Co. in San Jose, Calif., visited with his wife and spoke of his acquaintance with **Joel E. Schindall**, '63, SM '64, PhD '67, (now president of Loral, formerly with W-J), and **Kevin D. Stoddart**, '71, SM '72, EE '73, (with Watkins-Johnson).... **Stephen M. Foster**, '88, SM '90, was on campus for the Tau Beta Pi-sponsored fall-term Career Fair, representing his employer, Andersen Consulting of Boston.... At the same TBPI Career Fair were **David S. Miller**, '91, SM '91, and **Steven L. Rohall**, '87, SM '88, representing their employer, Bellcore.... A note from **Chester M. Day, Jr.**, '57, SM '58, mentions that **Marshall G. Schachtman**, '57, SM '58, is retiring to his "castle-in-the-sky" in Colorado (and this makes me aware of how time has transpired, as I knew Marshall as a student early in my MIT career).... **Steven C. Webster**, '78, SM '79, who is a laboratory manager at 3M's Data Storage Products Division in Minnesota, came in for a pleasant visit.

Plans are slowly advancing towards VI-A's 75th Anniversary Celebration for this coming June. I've talked over ideas with the several alums who've called or visited the office. The Alumni/ae Office has already sent out a "Save the Date" reply card mailing and if you haven't received one please let the VI-A Office know (617-253-4644). The reply card is an indicator of interest only, not a firm commitment. Your letting me know will also help with the VI-A database I am attempting to establish for sending graduates future information about the celebration! June 5th and 6th will be the dates.—**John Tucker**, director (emeritus), VI-A Program, MIT, Rm. 38-473, Cambridge, MA 02139-4307.

VII BIOLOGY

Biolog, Inc., of Hayward, Calif., founded by **Barry R. Bochner**, '70, SM '71, chair and VP for R&D, and **Donald W. Barnby**, '56, SM '57 (X), president and CEO, has



B.R. Bochner

received the "R&D 100" award from *R&D Magazine*. The award is presented each year for the 100 most significant technical products in the world. Biolog received the honor for "developing, and bringing to market, a new technology for the identification of bacteria and yeasts."

According to a company news release, "Biolog's new technology is a watershed development in microbiology. It holds the promise of unifying the

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Applied mathematicians

Principals:

Daniel Zwilling, '78, PhD
Michael T. Strauss, '79, PhD '85

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Architects	212-371-4675
Surveyors	
Planners	Jericho, NY
Geologists	516-338-4500
Soil Scientists	
Municipal Specialists	Boston, MA
Landscape Architects	617-783-0404
Environmental Consultants	Providence, RI
	401-751-2235

Florham Park, NJ
201-822-2600

Robbinsville, NJ
609-259-0640
Manchester, NH
603-623-5544

Rocky Hill, CT
203-529-7727

Washington, DC
202-785-8433

identification of virtually all bacteria and yeasts under a single chemistry for the first time in history. Biolog has been able to achieve a method of bacteria identification that is universal by developing a chemistry that responds to the respiration process of a cell—a process that all living cells have in common. An important by-product of this development is a huge database of information about what chemical compounds various bacteria can metabolize. This is a valuable resource in itself as humankind increasingly utilizes bacteria in manufacturing processes, or to destroy toxic pollutants.” . . . **Philip A. Sharp**, professor and director of the Center for Cancer Research at MIT, has been honored with an OAK Award for his achievement in public life. The OAK Awards, presented by the Kentucky Advocates for Higher Education since 1987, are given to people who have received undergraduate degrees from Kentucky colleges and universities and have achieved a national reputation in their careers. OAK stands for outstanding alumnus of Kentucky.

The Alumni/ae Association has been notified that **Marvin H. Cantor**, SM '59, of Rockville, Md., died on May 16, 1991. There was no further information provided.

VIII PHYSICS

Frank Y. Chu, PhD '72, sends word from Toronto, Ontario: “I’m glad to see that MIT has the top score in academic recognition in *U.S. News & World Report*’s ratings. If that score is weighted more heavily, MIT will be in the top five.” . . .

Andrew Cumming, PhD '89, reports: “In October 1990 I was named assistant professor in the Department of Physics at the University of Florida. In April 1991 I was given a Presidential Young Investigator Award for ‘Kinetics of Phase Transitions.’” . . . **Martin S. Ewing**, PhD '71, is now directing the science & engineering computing facility at Yale University.

X CHEMICAL ENGINEERING

Steven J. Anderson, SM '78, writes from Dublin, Calif.: “Last spring I sold the hazardous waste management business I founded in 1982. I started a new company called ADM Resource Recovery, Inc. This new corporation is doing business in the Central Valley of California as a resource recovery/recycling business for organic solid waste.” . . .

Richard L. Bolin, SM '50, reports: “As founder and director of The Flagstaff Institute in Arizona, I now manage the Secretariat of the World Export Processing Zones Association (WEPZA), a group of 25 EPZs in 20 countries employing over 400,000 export workers at the leading edge of global manufacturing competitiveness.” . . . From Philadelphia, Pa., **Bayard T. Storey**, SM '55, writes: “I recently completed four years as a regular member of the Reproductive Biology Study Section in the Division of Research Grants at the National Institutes of Health. The funding situation is a bit grim, and the ‘population explosion’ is thought by many—most mistakenly—to have gone away. But the science remains invigorating. I chaired a Gordon Conference on ‘Fertilization and Activation of Development’ in August 1991. The advances in cell cycle research, particularly as it applies to the conference topic, are mind-boggling. A bit far from Parlin, N.J. Practice School, but the point is, Course X training prepares one for anything in life!”

From Okemos, Mich., **Carl M. Cooper**, ScD '49: “Publication: ASEE Annual Meeting Session 3213 last June in New Orleans. ‘Dist: A Computer Supplement in Teaching a Grad Distillation Course.’” . . . **Akira Suzuki**, SM '63, reports from

Kawasaki-shi, Japan “I have resigned from Chiyoda Corp. as of April 30, 1990, where I served for 31 years.” . . . **Steven Chansky**, SM '67, writes: “I am president and CEO at Vaisala, Inc., in Woburn, Mass. We are celebrating our 10th anniversary. In 10 years Vaisala has become the leading supplier of meteorological instrumentation and systems in North America. Vaisala, Inc., is a wholly-owned subsidiary of Vaisala OY headquartered in Helsinki, Finland.” . . . **Gordon Burck**, SM '75, writes from Washington, D.C.:

“After three years at the Federation of American Scientists I published with Ambassador Charles Flowerree, *The International Handbook on Chemical Weapons Proliferation* (Greenwood Press, 1991). I am now a senior policy analyst at EAI Corp. in Alexandria, Va., working to support the negotiations on the Chemical Weapons Convention.” . . . From Carlisle, Mass., **Charles T. Hughes**, ScD '62, reports: “I am a staff scientist for Textron Defense Systems. My other activities include singing in the Concord Chorus and Longy Chamber Chorus, playing ice hockey twice a week year-round, serving on a church committee, scuba diving, hiking, woodworking, and bird-watching photography.”

Nelson Bogart, SM '39, sends word from Atherton, Calif.: “I am very sorry to have missed the 75th anniversary celebration of the School of Chemical Engineering Practice, since Doris and I were so close! We left New York October 1st on the New Crystal Harmony for a cruise to Montreal. It would have been a great experience to visit with the super group that went through the stations in the fall of 1938.” . . . From Madison, Wis., **Warren E. Stewart**, ScD '51, reports: “I am the 1991 recipient of the Byron Bird Award for Excellence in a Research Publication. I received the award for the paper ‘Solution of Boundary-Value Problems by Orthogonal Collocation,’ written with John Villadsen.” . . . **Larry Sewell**, SM '70, CHE '72, writes: “I am currently a business manager of olefins for Oxychem in Houston. I’m married with two daughters: Lauren, 12, and Erica, 10.” . . . **Marc Machbitz**, SM '78, reports: “I am now team leader for human resource services at Chevron Research & Technology Co. in Richmond, Calif.” . . . **Richard D. Packard**, SM '51, sends this update: “Three years university faculty (assistant professor of chemical engineering); 12 years industrial experience (principal development engineer at Honeywell; project leader, cleveite, Electronics Corp. of America; director of research at Infrared Industries, Inc.); four years government service (NASA Electronics Research Center); 20 years consulting engineer; colonel in the USAR Corps of Engineers; now retired.”

Biolog, Inc., of Hayward, Calif., founded by **Barry R. Bochner**, '70 (VII), SM '71, chair & VP for R&D, and **Donald W. Barnby**, '56, SM '57, president and CEO, has received the “R&D 100” award



D.W. Barnby

from *R&D Magazine*. The award is presented each year for the 100 most significant technical products in the world. Biolog received the honor for “developing, and bringing to market, a new technology for the identification of bacteria and yeasts.” According to a company news release, “Biolog’s new technology is a watershed development in microbiology. It holds the promise of unifying the identification of virtually all bacteria and yeasts under a single chemistry for the first time in history. Biolog has been able to achieve a method of bacteria identification that is universal by developing a chemistry that responds to the respiration process of a cell—a process that all living cells have in common. An important by-product of this devel-

opment is a huge database of information about what chemical compounds various bacteria can metabolize. This is a valuable resource in itself as humankind increasingly utilizes bacteria in manufacturing processes, or to destroy toxic pollutants.” . . . From Naples, Fla., **Charles A. Stokes**, ScD '51, reports: “I serve on the advisory boards of the Chemical Engineering Department at the University of Florida and the Florida Solar Research Center. I also chair the committee advising U.S. Representative Porter Goss on energy legislation and policy.” . . . **William F. Beck**, ScD '64, has been named European regional manager for the FMC Corp. in Brussels. Previously, he was VP and group manager in the firm’s Philadelphia office. . . .

Robert R. Chase, SM '39, of Austin, Tex., died on January 12, 1991. He was employed as a chemical engineer for Texaco, Inc., for 35 years and was retired at his death.

XI URBAN STUDIES AND PLANNING

Bruce Joffe, MCP '78, MAA '78, reports: “I have joined PlanGraphics, Inc., a leading GIS consulting firm, to open their West Coast office in Concord, Calif. I have been providing implementation planning services to city and county governments and utility districts for 12 years, and look forward to building a national and international practice with PlanGraphics. I’m still happily married to Karen, our oldest daughter is a senior in high school, and second daughter is a sophomore. They’re getting older, but we’re staying the same!” . . . **Robert Schwartz**, MCP '68, notes in brief: “Won A.I.A./Washington Residential Design Award for Grace Church Condominiums.” . . . From Littleton, Colo.,

Barbara Cole, MCP '80, writes: “I am president of a small ‘home office’ consulting service, specializing in community development primarily in the Western U.S. I continue to work with other alumni & faculty including: David G. Cooper, MAR '80 (IV), **Andy D. Reamer**, MCP '81, PhD '87, and **Phil B. Herr**, MCP '59 (IV). . . . **Barbara G. Fields**, MCP '85, sends word: “Anne B. Wilson, MCP '85, is program director of the new Local Initiatives Support Corp. (LISC) office in San Diego. LISC is the nation’s largest financial intermediary for community development. I am opening a new office based in Providence, R.I.” . . . According to a Doylestown, Pa., newspaper, **Elizabeth K. Emerson**, MCP '78, has resigned as director for the Bucks County Planning Commission in Doylestown. . . . **Kathleen S. Barat**, MCP '86, is now executive director of the Franklin County Community Development Corp. in Greenfield, Mass. Previously, she was director of the Maine Aspirations Foundation in Augusta, Me.

XII EARTH, ATMOSPHERIC, AND PLANETARY SCIENCES

Gunter Faure, PhD '61, writes: “I am a professor of geology at the Ohio State University where I teach geochemistry and planetary geology. Most of my research activities are in Antarctica, which I have visited nine times. I am also the executive editor of a scientific journal called *Geochimica et Cosmochimica Acta*.”

Robert L. Green, ScD '40, of Cherry Hill, N.J., died on September 28, 1991. A Fellow of the American Ceramic Society, he joined Lenox China Co. in 1947. After 39 years of service he retired from Lenox in 1986, but continued to serve in a consulting role. Before joining Lenox, he worked in the research laboratories of General Electric in Schenectady, N.Y. Green was a past president of the New Jersey Ceramic Association and received the “Man of the Year Award” in 1979. He developed Lenox Temper-ware and Lenox Oxford bone

china. He was an accomplished violinist. . . . **John C. "Jack" Johnson**, SM '46 (XIV), ScD '48, of Worcester, Mass., died on June 15, 1991. Johnson was a professor emeritus at Worcester Polytechnic Institute. Early in his career he was a research associate and lecturer in physics at Tufts University and a professor at MIT. He joined the WPI faculty in 1954 and served for 25 years until his retirement in 1980. In 1954 Johnson wrote a textbook, *Physical Meteorology*, that was used in colleges throughout the country. In 1976 he was honored by the National Weather Service for his work in the weather field. Johnson flew a P-38 in the Army Air Corps during WWII. He served in the European-African-Middle Eastern theater, and flew on weather-reconnaissance missions over Italy. For six months he was held prisoner by the Germans. He was released as a lieutenant colonel, then served many years in the Air Force Reserve.

XIII OCEAN ENGINEERING

Harilaos N. Psarftis, SM '77, PhD '79, writes: "After 15 years at MIT (from 1974-79 as a graduate student, and from 1979-89 on the faculty of the Ocean Engineering Department), I moved to Greece in 1989. I am now professor of shipping and shipbuilding management at the National Technical University of Athens, and am engaged in teaching and research in marine transportation. I'm starting a new international project within the

EURET R&D program of the EEC. I'm visiting Boston about twice a year to touch base with friends at MIT and check on the Celtics (of which I am a big fan). I am VP of the MIT Club of Greece." . . . **David R. Saveker**, SM '46, sends word from Pismo Beach, Calif.: "I am still active as a consulting naval architect and marine engineer. However, I'm spending more time doing watercolors—seascapes and boats, mostly. I think of my classmates and shipmates fondly." . . . **Jon J. Bryan**, SM '73, OCE '73, reports: "I retired from the Navy in 1981. For the past six years I have been a senior analyst for the American Institutes for Research in Bedford, Mass., working on the Air Force's E-3 AWACS program. The Air Force moved me to Hanscom AFB, about three years ago to work at the E-3 Systems Project Office (SPO). For the first time in many years I am working on a software development project that really works! It is a pleasure to work with NATO at Brunsum Holland and Gielenkirchen GE, the USAF at Hanscom AFB, Mass., and Tinker AFB, Okla., and with Boeing Aerospace in Seattle, Wash." . . . **Geetha Rao**, PhD '87, sends word from Newark, Calif.: "I am now thoroughly enjoying working at Failure Analysis where I am consulting in the area of risk assessment."

Tom Marnane, NE '64, reports: "I am with Matson Navigation, Co. in San Francisco as VP for facilities, equipment engineering, and maintenance, and general manager of purchasing. Charlotte and I see **Marilyn Pollack** (widow of **Bob**, SM '64 (VI), NE '64) frequently." . . .

Lieutenant Commander Kevin Carpentier, SM '82, writes: "In March 1991 I was transferred to the Coast Guard's Maintenance and Logistic Command-Atlantic. I am Chief of the Aids to Navigation/Icebreaker Section that schedules and administers all major repairs/overhauls for 88 cutters of various classes." . . . From Pasadena, Calif., **Howard Fong**, SM '74, reports: "I am now an entrepreneur building my privately owned company in the field of leather travel luggage and business cases as a manufacturer of my brand-name, Eurodesign products." . . . **Donald P. Courtsal**, SM '56, sends word from Pittsburgh, Pa.: "I am a financial consultant working as general manager of Allegheny Financial Group and on acquisitions for investor groups. I am chair of the Audit Committee for the Society of Naval Architects and Marine Engineers. I have two sons, one finishing residency in internal medicine, and the other working in Portland, Ore." . . . **Captain William A. Dewey**, SM '74 (II), OCE '74, was transferred in August 1991 to the Long Beach Naval Shipyard in Long Beach, Calif. He is a business/planning officer on a three-year assignment. . . . From San Diego, **George A. Uberti**, SM '54, writes: "It is almost three years since I retired from Nassco. I am enjoying my retirement very much." . . . **Pabitra Mukerji**, SM '80, reports: "I have been promoted to supervisor of Naval architecture at corporate headquarters of McDermott International in New Orleans. My department is responsible for R&D and design of McDermott's worldwide fleet of floating offshore vessels. We design fixed offshore platforms and support shipyard activities. I have traveled extensively on all the continents within my current position at McDermott."

Captain Louis H. Roddis, Jr., SM '44, of Charleston, S.C., died on September 15, 1991. Roddis, an engineer who helped design the first nuclear submarine, was president and vice chair of Consolidated Edison Co. from 1969 to 1974. He joined Con Edison from General Public Utilities Corp., where he has been director of nuclear activities and chair of the board of Pennsylvania Electric Co., a GPU subsidiary. Roddis was an early member of the Atomic Energy Commission Division of Reactor Development.

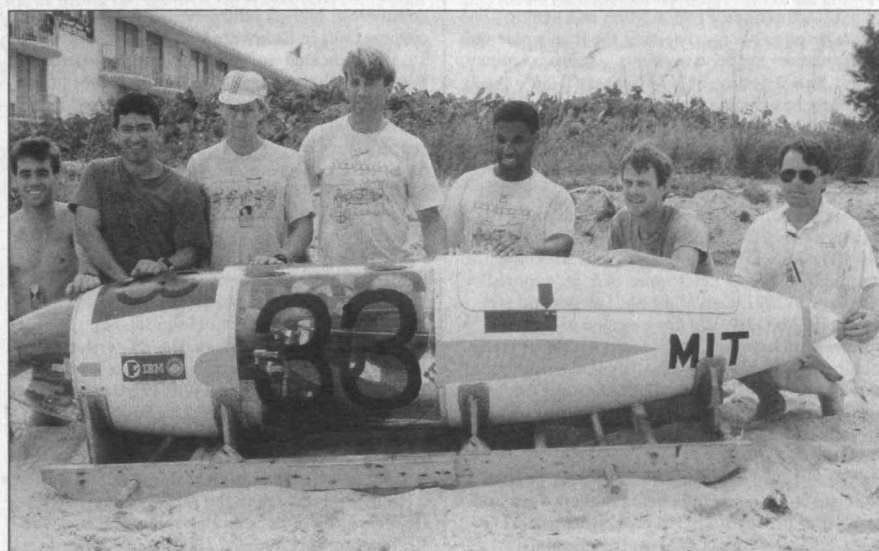
XIV ECONOMICS

Doug Engmann, SM '70, writes: "I was elected director of the National Securities Clearing Corp., appointed commissioner with the City Planning Commission in San Francisco, and am president of Sage Clearing Corp." . . . **Richard S. Steinberg**,

'77, recently joined the faculty of Indiana University/Purdue University at Indianapolis (IUPUI) as associate professor of economics. Steinberg also holds an appointment as adjunct associate professor of philanthropic studies for the Indiana University Center on Philanthropy. Formerly associate professor of economics

R.S. Steinberg

at Virginia Polytechnic Institute and State University and director of undergraduate studies in economics, Steinberg is nationally known in the field of economics of the nonprofit sector. . . . From New York City, **Ruth G. Shaeffer**, PhD '46, reports: "I was elected president and director of the new nonprofit Center for Total Quality Management in Healthcare, Inc. I'm also president and director of the Roosevelt Island Council of Organizations, Inc."



A Submarine Built for Two

Off the beach at Singer Island, Fla., MIT's Sea Beaver was among 34 human-powered submarine entrants competing in the Second International Submarine Races. Each flooded vessel contained teams of two clad in scuba gear. Although the Sea Beaver only garnered fifth place, its crew received the annual Popular Science Engineering Excellence Award—a \$2,000 scholarship—for designing, building, and racing the vessel. It was the smallest and lightest of the subs, with carbon fiber blades mounted on an articulated tail. Unlike Icarus, a previous incarnation, the Sea Beaver's tail can

move up and down as well as left and right. Also presented was a plaque that hangs in the Hart Nautical Museum in Building 5. Clifford A. Goudey, Fisheries Engineer in the MIT Sea Grant Program, says the award will be used to support future UROP programs and to help encourage students in the field.

From left: **Bill Hall**, '91; pilot **Laureano Cangahuala**, '87; propulsor **Hauke Kite-Powell**, '84; **Cliff Goudey**, SM '77; **Anthony Joseph**, '88; **Malcolm Child**, '92; and **Richard Stepler**, Popular Science editor.

Charles V. Brown, '58, of Stirling, Scotland, died on July 27, 1991. A long and eloquent obituary by a colleague appeared in the *Independent*, a British newspaper. Here is a condensed version: Brown began his career as a lecturer in the University of Ibadan in Nigeria where he was involved in economic research with a particular interest in the problems of establishing an indigenous banking system. He and his wife, Sally, are remembered as having a widely extended interest in their adopted country—in its history, its customs, and cultural achievements. In 1964, Brown joined the Department of Political Economy at Glasgow University. There he established his position as a dedicated teacher and a clear expositor who could even unravel for his students the intricacies of welfare economics. He completed a book on Nigerian banking, *The Nigerian Banking System* (1966). In 1978, he and Peter Jackson wrote *Public Sector Economics*, widely used as a university text. He then moved to Stirling University as a professor of economics from 1970 to 1989, where



C.V. Brown

he was involved in the administration of a growing department. Brown took a broader view of economics—he saw the need to draw on psychology for his research on incentives and he was aware of the links with politics. His third book was *Unemployment and Inflation: An Introduction to Macro Economics* (1986). His writings were not confined to economics but also included the history of the characteristics of classic sailing boats—an appropriate subject for the great-grandson of a Shetland sailor. In 1989, he took early retirement, which allowed him time for scholarly pursuits and also for a private family business in which he could display the qualities of entrepreneurship of which he had so often written. His concern for social welfare was undiminished and he devoted much time to voluntary work with the Citizens Advice Bureau.

Daniel R. Siegel, PhD '83, died on October 20, 1991. The University of Washington professor, aged 35, suffered a heart attack while riding his bicycle on campus. Siegel was the Piggott/Paccar Professor of Business Administration, co-author with his wife, Diane, of *Futures Market*, and editor of another book, *Innovation and Technology in the Markets: A Reordering of the World's Capital Market System*. He was a former associate professor at the J. L. Kellogg Graduate School of Management at Northwestern University, where he was named teacher of the year in 1986. Siegel joined the UW faculty last year after being recruited because of his internationally known expertise in electronic trading and option markets. His major research interests included corporate finance, options and future markets, natural resource economics, and industrial organizations.

XV MANAGEMENT

Jacob Akoka, PhD '78, reports: "I have been appointed dean of the faculty at ESSEC (Ecole Supérieure des Sciences Economiques et Commerciales), one of the two best business graduate schools in France." . . . From Munich, **Christoph F. von Braun**, SM '74, writes: "After 12 very good years with Siemens it was time for a change. So, I am now teaching, writing, and doing independent consulting. I'm not going to get very rich this way, but I am certainly leading an interesting life and having a good time." . . . **Donna Williamson**, SM '76, sends word from Wilmette,

Ill.: "**Scott Williamson**, PhD '82, and I welcomed Christopher Scott Williamson to our family March 1, 1990. He joins a brother, Erik, who is eight years old. Scott is VP for mergers and acquisitions at Intel. I manage several divisions in Baxter's fast growing Alternate Site group." . . . **Lawrence B. Kilham**, SM '65, writes from Secaucus, N.J.: "I just started a new company to make low-cost instruments for environmental monitoring, called Eco Sensors, Inc. The first product is a shirt-pocket air quality monitor for industry and consumers." . . . From Nada, Kobe, Japan, **Toshihiro Kanai**, PhD '89, reports: "I am currently an associate professor at the School of Business Administration at Kobe University. I published a book on Japanese transformational middle managers last June. I also interviewed 20 Japanese CEOs to learn their native views about human resources and the result was published in book form. Unfortunately, both books are written in Japanese; but if you have a friend who understands Japanese, they may be of some interest."

Walter Greenberg, SM '80, sends word: "I survived yet another Citibank restructuring effort! I'm now responsible for all ATM-related undertakings (e.g. enhancements, deployment, shared networks) across both the U.S. and Latin America. I suppose it's time to dust off my ninth-grade Spanish ('pigeon', at best!) and earn some more frequent flyer miles. Also, looks as if I'll be relocating back to the Big Apple (from the Windy City) by year-end." . . . **Arthur P. Alexander**, SM '58, is still president of API, Inc., in Weston, Mass. He says there is no additional news since his last update. . . . **Steven P. Somes**, SM '83, recently joined Gardner and Preston Moss as a senior VP and is responsible for directing the firm's management services for private clients. . . . From Quincy, Mass., **Rob Brierley**, SM '75, writes: "I left a big corporate environment over a year ago for the opportunity to run Cybergraphic Systems, Inc., a \$7 million software company that sells to the newspaper industry. Challenges, rewards, pressures—the experience is everything I had hoped and expected. On the home front: Cindy and I welcomed our third child (Alexander) on May 22, 1991. The kids (Tim, 5, Molly, 3, and Alex) keep us running." . . . **Steve Leichtman**, SM '86, reports: "On June 6, 1991, Gail and I had our second son, Devon Aleksander. We have moved to larger quarters in Lexington, Mass., and are desperately looking to sell our Brookline, Mass. condominium (anyone interested in speculating on real estate in Boston?). I am working as an organization design specialist at Temple, Barker, and Sloane/Strategic Planning Associates in Lexington."

Marc S. Freed, SM '82, writes: "I have left the financial world after nine years in New York and London to pursue a PhD in economics at NYU's Stern School of Business." . . . From **Bernard Shapiro**, SM '58: "I completed 30 years of teaching at the University of Massachusetts at Lowell in December and I'm looking forward to many more. Yana and I are still going strong after 33 years of marriage. I joined the physical fitness craze 30 years ago and started running, progressed to marathoning (5 times in Boston and broke 3 hours twice). For the past five years I have gone heavy into mountain climbing—U.S., Canada, and Europe." . . . **Ryosuke Mizouchi**, SM '88, is working in the Planning and Control Department in the Beer Division at Kirin Brewery Co., Ltd., in Tokyo. He recently got married. . . . **Shannon Wells**, SM '91, writes: "After a great summer trip to Greece and Turkey where we saw **Chris Papouras**, SM '91, and Enis Pendar. **Mark Atkeson**, SM '91, and I are in Hartford at UTC. We have recently gotten engaged and are planning an April wedding before we begin assignments in Europe. Hope we'll see a lot of Sloanies then!" . . . **Bob Gref**, SM '87, is working for Smart Star Corp. in Oakbrook Terrace, Ill., as a consulting manager."

From Sint-Truiden, Belgium, **Ludo F. Gelders**,

'72, writes: "I serve as president of CLAIU, the liaison committee of university graduate engineers in the E.C. CLAIU was established in 1988 by eight national engineering associations within the European Community. It is heavily involved in the problems of European directives concerning the engineering profession, more particularly the free movement of engineers and provision of engineering services within the European community." . . . **Michael A. Tippie**, SM '89, writes: "Our second child, Elliot Ryan Tippie, was born on April 29, 1991. Work is going well for me—one of the companies I invested in (Cellpro, Inc., in Rothell, Wash., a manufacturer of cell-separation systems for bone marrow transplantation) is now going public. We have bought a house in Seattle. I've spent quite a bit of time hiking with my 3-year-old daughter, Monica, this summer. My wife continues as an instructor in anaesthesiology at the Virginia Mason Clinic in Seattle." . . . **Brian R. Harris**, SM '90, SM '90 (VI), is a senior associate at CSC Index in Cambridge, Mass. He writes: "Shari Polur and I were engaged in May. Shari is an attorney with the FDIC. A 1992/93 wedding is planned." . . . **Sharyn (Hardy) Gallagher**, SM '85, writes: "Fred and I had a second child, Brian Patrick, on September 2, 1991—8 lbs. 10 oz. brought a new meaning to the holiday Labor Day! Our 4-year-old Glen thinks little brothers are great. Fred has started his own business, Charles Frederick Jewelers, in Chelmsford, Mass. It has been a lot of fun (and work) becoming entrepreneurs, especially during a recession."

From Haverford, Pa., **Joseph V. Iemolo**, SM '62, writes: "At AT&T I am an account executive in a commercial branch selling network services to corporations in Delaware County. On September 19, 1991, I hosted an MIT Club dinner featuring President Charles Vest. I'm past president of the MIT Club of Delaware Valley and I served two years on MIT's National Selection Committee, representing District 5. (I have served 20+ years on the executive committee of the Mid-Atlantic MIT Club)." . . . **Geoff Brooks**, SM '79, reports: "Maria and I and our three sons have recently moved from Eugene, Ore., to Philadelphia, where I'm teaching and researching in strategic management at the Wharton School." . . . **Gregory Uvieghara**, SM '83, is a member of the technical staff at AT&T Bell Labs in Holmdel, N.J. . . . From San Francisco, **Allan Wiser**, SM '89, writes: "I am a sales manager for a health insurance company. I just spent 11 days in Israel with fellow classmate **David A. Birnbach**, SM '89." . . . **Sandra Perry**, SM '83, writes: "I'm the business development manager for the Systems I.C. Products Division at Analog Devices in Norwood, Mass. Major markets for our products are in the rapidly expanding field of wireless and cellular communications. Last December I married David Kneeland and we're building a house in Cohasset, south of Boston. Hope to move in soon!"

R. Brian Fifer, SM '71, reports: "I am president and CEO of Aquacare, Inc., an industrial water purification systems and services company that is located in Hollywood, Fla." . . . **Sven A. Wehrwein**, SM '80, sends word: "After the demise of Drexel Burnham in February 1990, our family relocated from London to Minneapolis. Now in my twelfth year of investment banking, I'm a partner with Wessels, Arnold & Henderson, a Minneapolis-based research-driven investment banking boutique." . . . From Bayamón, Puerto Rico, **Carlos Mateo**, SM '89, writes: "Doing just great with my wife, Roxana, my older daughter, Maria Jimena, 2, and my newborn daughter, Ana Gabriela. I was recently promoted to brand manager at the Procter & Gamble Co. I'm enjoying the beach, the sun, and the waves of the Caribbean." . . . **Sarah Shoaf Cabot**, SM '85, reports from Malvern, Pa.: "I took the fall semester off from law school after having a baby boy, Charlie, in June. We're all doing well and I'm even having some time to do some technology licensing con-

sulting on the side."... **Scott Beardsley**, SM '89, reports: "I transferred to McKinsey's Brussels office from New York City at the end of September for a one-to-two-year tour of duty. My wife Claire and I are expecting our first child in early February."

Melford E. Monsees, '58, writes: "I am active in American Society of Civil Engineering, National Society of Professional Engineers, Missouri Society of Professional Engineers, American Society of Engineering Education, and two construction engineering education organizations. I am also a member of MIT's Engineering Education Council, where we develop references in engineering activities and give talks at conferences and meetings in various cities around the U.S."... **Alison Mark**, SM '89, and **Johannes Hoech**, SM '88, send word from Menlo Park, Calif.: "We are the proud parents of a new baby girl, Haley Katharine, born August 23, 1991."... **Richard H. Bushnell, Jr.**, SM '85, is VP of the Client Coverage Group at Bankers Trust in Los Angeles, Calif. Previously, he was an associate in private finance in the Investment Banking Division at Goldman Sachs & Co. in New York City.... **Thomas B. Martin, Jr.**, SM '81, is VP for marketing at Dell USA in Austin, Tex. Previously, he held the same title at Toshiba American Information Systems in Irvine, Calif.... **David F. Gatto**, SM '88, is a senior VP for strategic planning at LEK Partnership. Previously he was a manager at the Los Angeles-based company.

The Alumni/ae Association has been notified of the following deaths: **Kenneth R. Gobeille**, SM '81, of Montreal, Quebec, on August 31, 1991, and **Thomas Rolf Petersen**, SM '90, of Munich, Germany, on August 1, 1991. There was no further information provided

Sloan Fellows

From Powell, Ohio, **Thomas A. Helmuth**, SM '77,

reports: "I joined Metro Health as senior VP for Medical Affairs and associate dean at Case Western Reserve University's School of Medicine in February 1991."... **Larry C. Atha**, SM '82, chief of the Key Technologies Division at the U.S. Army Strategic Defense Command in Huntsville, Ala., reports: "Our son, Larry II, graduated in mechanical & aerospace engineering in December 1990 from Auburn University, and started work in January with the U.S. Army Missile Command. To celebrate, Patty bought me a motor home in March and we have been traveling the Smoky Mountains and Gulf beaches. Patty is writing a novel about the big guns in Iraq and I'm still working on Star Wars technology. Ciao."... **John T. Howley**, SM '73, sends word: "I'm currently engaged in reformulating international activities of the National Association of Realtors, including programs in Eastern Europe and the Soviet Union. In addition, my wife and I are running a charming B&B Inn on Solomons Island on the Chesapeake."...

Carol Corvi, SM '88, reports: "I was recently appointed director of program management in the Boeing Commercial Airplane Group, 737/757 Division in Seattle, Wash."... From Okemos, Mich., **Larry Zahner**, SM '89, writes: "I have been appointed plant manager of the Lansing Craft Centre, which is slated to build GM's first electric car, 'The Impact' in the mid 1990s."... **Kate Fickle**, SM '86, is director of marketing selection in White Plains, N.Y. She has recently returned from living in Japan.... **Stewart Verge**, SM '87, was promoted to VP for Network Services at Bell Canada on July 1, 1991. he says: "I moved from Ottawa to Toronto (fourth move since Sloan School). I have experienced a broad diversity of interesting jobs since graduating from Sloan."

Carl D. Peterson, SM '72, owner of CD Peterson Associates in Brookfield, Conn., writes: "I am starting on my next book. It's aimed at everyone worried about job security."... **Russell C. Youngdahl**, SM '63, sends word from Jackson,

Mich.: "I'm retired again. This time from Long Island Lighting Co. as president and director. Life has truly been good."... From Denver, Colo., **Michael Henshaw**, SM '88, writes: "I was appointed group VP for business development of Martin Marietta Astronautics Group, named to the University of Tennessee College of Engineering board of advisors in Knoxville, Tenn., and named to UT's Quality Improvement Team formulating the College of Engineering's Total Quality Management Program."... **Carl A. Erikson**, SM '90, VP of the Ohio Power Co., in Canton, Ohio, has been named to the advisory board at Walsh College in North Canton.... **Laurence S. Liebson**, SM '79, has been named chair of Xyvision, Inc., Wakefield, Mass. Previously, he was president and CEO of the firm.... **John P. Bucter**, SM '81, is president of the Network Cable Business Division at AT&T. Previously he was VP of the Business Markets Group at AT&T Information Systems.... **Stevenson Langmuir**, SM '64, has assumed the position of VP for finance and administration at the SinterCast Corp. in Auburn Hills, Mich. He is responsible for directing all financial and administrative activities including human resources, planning, and logistics. Langmuir was previously with Standard Products Co. as VP for administration and with the Ford Motor Co. for more than 20 years with experience in business planning, data interpretation, competitive analysis, and financial operations.... In the November/December 1990 issue we reported an incorrect job affiliation for **Philip B. Fletcher**, SM '70. He is president and COO of ConAgra, Inc., and a member of ConAgra's board of directors. He was named to those positions in July 1989. Fletcher previously was president and COO for ConAgra Prepared Food Companies, and a member of ConAgra's Office of the President. We regret the error.

Irving Levinson, SM '61, of Silver Spring, Md., died on February 26, 1991. He was a retired eco-

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nomic analysis and operations research chief of the Defense Supply Agency. He served in the Navy in Europe during WWII and after the war he worked for the Army quartermaster general, joining the Defense Supply Agency in 1961. He was an executive assistant to the Army Material Command's commanding general in Europe from 1966 to 1969. He then working for Defense Supply until retiring in 1974. . . . **Bryant Gunsenhouse**, SM '56, of Anderson, Ind., died of liver cancer on August 3, 1991. In April 1982 he retired from Delco-Remy-GMC. During his retirement he built a barn for his woodworking. . . . **Conoco employees H. Kent Bowden**, SM '68, and his wife Connie, and **William K. Dietrich**, SM '71, and his wife Gayle, all of Houston, Tex., died on September 4, 1991. The two couples were aboard a twin-engine executive jet that crashed on the island of Borneo while approaching the airport at Kota Kinabalu for refueling. The nine passengers and three crew members were on a business trip that was to include visits with Conocoans, government officials, and joint-venture partners in the Middle and Far East. Bowden was senior VP for administration, and Dietrich was executive VP for exploration and production. Conoco Oil, a subsidiary of Du Pont Co., held a memorial service on September 12, 1991.

Senior Executives

Irvan Prawiranata, '89, manager of the small-scale credit division at Bankexim in Jakarta, writes: "In Indonesia each bank is set by the government to help small-scale entrepreneurs, providing them with a minimum of 20% of the banks' total credit given, to develop and equalize economic growth and capital formation at urban and village areas. Now I have a task to search for a concept of training and development for small-scale entrepreneurs, who are eligible for the 20% of Bankexim's total credit that as of June 1991 amounted to U.S. \$3.4 billion. My knowledge from MIT inspires me to find that concept." . . . **John J. Arntz**, '74, sends word from Shelby, Ohio: "I received the 1991 Outstanding Senior Citizen Award from the Shelby Rotary Club for chairing successful capital fund drives for the Shelby Memorial Hospital and the Shelby 'Y' Community Center." . . . From Westfield, N.J., **Giovanni Fei**, '67, reports: "Since retiring from Olivetti in March 1990, I have been doing consulting work for computer companies." . . . **W.B. Dronen**, '78, writes: "I have left the senior management of Caterpillar, Inc., to form a business consulting firm, The Himalayan Group, Inc., with offices in Charleston, S.C. The firm has two separate divisions. The first is organizational design consulting with evaluation of existing management structures and design of new structures for firms merging, expanding, or downsizing. The second is career change and job search for senior management and professionals. I am a certified professional consultant and the author of *Report Monday: Ideal Job, Ideal Employer*." . . . **Lee Hibbs**, '90, reports from St. Louis, Mo.: "I left Mallinckrodt Medical to take over the presidency of Electro-Catheter, Inc., in Rahway, N.J. I did not last two months after the Senior Executive Program before I felt that I needed to change environment and company." . . . **James E. McCormick**, '68, retired in January 1992 as president and COO at Oryx Energy Co. in Dallas, Tex.

Peter L. Armstrong, SM '84, of Waban, Mass., died of leukemia on August 27, 1991. Armstrong was employed by the Fidelity Co. for the past five years. He had previously been employed in sales with AT&T in Boston and helped manage a fencing company in Newton. An avid outdoorsman, he enjoyed skiing and hiking in Vermont. . . . **Sir (Ronald) Gordon Jackson**, '71, of Pymble, Australia, died on June 1, 1991. He was formerly the chair of the Australian Industry Development Corp. in Sydney. . . . The Alumni/ae Association

has been notified of the following deaths: **Frederik O. Jeppesen**, '64, of Denmark, on April 23, 1991, and **Percy G. Holton**, '69, of Devon, England, on May 7, 1991. There was no more information provided.

Management of Technology Program

John Harrison, SM '83, has been promoted to VP at Parsons, Brinckerhoff, Quade & Douglas, Inc. As such, he is operations manager, second deputy regional manager of Parsons Brinckerhoff's New England Region in Boston, and involved in a variety of high speed rail and maglev studies, and in the design of the Massachusetts Bay Transit Authority's (MBTA) South Boston Piers Underground Transitway. . . . **Charles R. Bow**, SM '84, has a new position as senior consultant for The Technology Partnership in the United Kingdom. . . . **Gene Huang**, SM '85, has a new position as general manager for the Boston-based New England Deaconess Hospital. He is starting up a satellite office in West Hartford for the Home I.V. business. . . . **Rick W. Orr**, SM '85, has moved to Ogden, Utah, where he is now production manager for Flamenco, a company within the Aerospace Division of the Barnes Group, Inc. . . . **Nam-Kuan Teo**, SM '85, is now the executive director of Novo Quality Services Private Limited, a company in Singapore that provides consulting and training services in quality management. . . . **Frederick D. George**, SM '87, after 17 years with IBM, has started his own computing consulting practice in Boulder, Colo. His focus is on building client-server applications and successful relationships with IBM. . . . **Commander Tommy Gardner**, SM '88, has been assigned as financial management officer in R&D for the U.S. Navy's Chief of Naval Operations in Washington, D.C. He is also enrolled in a PhD program at George Washington University in economics. . . . **Christa Mayerl**, SM '89, wrote that she enjoyed a small class reunion at the home of **Cathy Iacobo**, SM '89, in Lexington, Ky. She and her husband spent a weekend with Cathy, Nancy and **Alex Clelland**, SM '89, and Joanne and **Randy Reynolds**, SM '89. . . . **Allan Wiser**, SM '89, and **David Birnbach**, SM '89, spent ten days in Israel last September. We're hoping to hear more about the trip. . . . **Yves Le Cars**, SM '90, has been promoted to director of the Emerging Technologies/Research Division-Europe, at Kodak-Pathe in France. . . . **Takehiko Nemoto**, SM '90, is now chief manager of the Systems Development Division at Mitsubishi Bank Ltd. in Tokyo. . . . **Kip Stevely**, SM '90, has a new position as chief engineer of Powertrain and Aerospace SBU for Delco Chassis Division at GM. . . . **Roberta Zald**, SM '90, has a new position as marketing planning manager for GM Ranuc Robotics Corp. She wrote that she "enjoyed seeing MOT classmates **Nori Stevely**, SM '90, **L. Craig Wall**, SM '90, **Kip Terada**, SM '90, and **Kozo Arao**, SM '90, at the wedding of **Pete Tomhon**, SM '90, and **Kelly Seymour**. Also she's "missing Boston/MIT and looking for an opportunity to return." . . . **Audie E. Hittle**, SM '91, has a new position at headquarters at Hanscom AFB. Captain Hittle is responsible for domestic technology transfer from U.S. federal labs to the commercial industrial sector; for international cooperative R&D; and for internal USAF technology transition. . . . **Mikihiko Kato**, SM '91, is presently chief engineer for the R&D Center in the Magnetic Products Division at Fuji Photo Film Co., Ltd. in Japan. . . . **Naoki Kato**, SM '91, has been appointed senior manager of research and planning at NTT. His area of responsibility is research management. . . . **Steve J. Siegel**, SM '91, is now manager of external alliances and development at IBM. He is working with visual subsystems in the entry systems division, managing the external alliances and development department which is responsible for managing a licensing agreement between IBM and sGs-Thomson for PC graphics

chips. Steve and Lesli Oaklander have set their wedding date for May 24, 1992 at the Boca Raton Hotel and resort in Florida. . . . **Edward Wong**, SM '91, has a new position as staff engineer at the Southern California Gas Co.—Fay Wallstrom, Management of Technology Program, MIT Rm. E56-304, Cambridge, MA 02139.

XVI AERONAUTICS AND ASTRONAUTICS

From Oslo, Norway, **Tore Christiansen**, SM '82, reports: "After nine years of working for Det Norske Veritas ship classification society, I have returned to student life at Stanford University (oops!) to pursue a PhD in civil engineering (oops again!). My studies will be in the area of construction management, with thesis work on application of communication theory and information engineering to the organization and management of large multi-functional design teams." . . . **Byron K. Lichtenberg**, SM '75, ScD '79, writes: "I'm in the final stages of training for my second space flight scheduled for March 1992. Our crew of seven will be conducting experiments investigating the upper atmosphere, the impact of solar energy on the Earth, and natural and artificial auroras." . . . **Marc P. Genain**, SM '75, is working on the operational and ergonomic design of the Channel Tunnel control centers. The operations project is slated to be completed in August 1993. . . . From Concord, Mass., **Edward B. Bokhour**, SM '88, reports: "My spaceflight experiment flew successfully aboard STS-48 *Discovery* this past September. I was hardware development manager at Payload Systems for the MODE experiment, under contract to MIT-SERC. MODE was structural and fluid dynamics." . . . From Big Bear Lake, Calif., **Creighton Cook**, SM '54, sends word that he continues as an aerospace consultant in the Southern California area. . . . **Charles Vehlouw**, SM '77, writes: "I have been selected as the Longbow Apache Program Director at McDonnell Douglas Helicopter Co. located in Mesa, Ariz." . . . In the November/December 1991 issue we incorrectly reported that **John Kenneth Haviland**, PhD '61, retired in 1969. He retired from the University of Virginia's Department of Mechanical and Aerospace Engineering as professor emeritus on June 1, 1991.

George T. Onega, SM '70, of Slidell, La., died on March 23, 1990. Upon graduation from MIT he joined the Bell Aerospace Co. as an engineer where he spent his entire professional career working on engineering applications for the aerospace and marine fields, rising to the position of director of advanced design. His work at Textron Marine Systems (formerly Bell Aerospace) involved surface effect ships for the U.S. government. . . . The Alumni/ae Association has been notified that Captain **Henry F. Lloyd**, SM '46, USN (ret.), of St. Augustine, Fla., died of a heart attack on June 12, 1991. There was no further information provided.

XVII POLITICAL SCIENCE

Franklin D. Margiotta, PhD '79, writes that as president and publisher of Brassey's (U.S.), Inc., he has "just published President Bush's *National Security Strategy of the U.S. 1991-1992*. As a press that supports the competition of ideas, Brassey's will soon publish a book developed by another MIT graduate, Representative Les Aspin, PhD '79 (XIV), chair of the House Armed Services Committee, entitled *Defense for a New Era: Lessons of the Persian Gulf War*." . . . **Vann H. Van Diepen**, SM '83, reports from Arlington, Va.: "I have been named director of the Office of Weapons Proliferation Policy in the Bureau of Politico-Military Affairs in the U.S. Department of State."

. . . Margaret O. Meredith, Stephen D. Nelson, and **Albert H. Teich**, '64 (VIII), PhD '69, are the editors of *AAAS Science and Technology Policy Yearbook 1991* (AAAS, 1991). According to the book jacket, "The editors have assembled a unique collection of informed discussions of the major science and technology policy issues of 1990-91. Topics range from the financial health of academic science to the state of the art in measuring payoffs from research to fraud and misconduct in science."

XVIII MATHEMATICS

From Urbana, Ill., **Douglas B. West**, PhD '78, writes: "I have been promoted to a full professorship in the Mathematics Department at the University of Illinois, effective August 1991." . . . **Bob Leonard**, SM '57, sends us a clip from the *San Diego Business Journal*. The article details the takeover of Ticketron by Ticketmaster, the Los Angeles-based ticketing firm run by Leonard. The company's 1991 revenues are projected at more than \$1 billion, up from \$650 million in 1990. Leonard said Ticketmaster was able to take the lead in the ticketing business with superior computer systems, aggressive marketing, and its introduction of telephone sales. Ticketron followed a few years later, but Leonard said he believes it was too late to stage a comeback. . . . The Mathematical Association of America held elections last September and has two MIT alumni on board. **Donald L. Kreider**, PhD '59, professor of mathematics and computer science at Dartmouth College will be the Association's 45th president. Kreider will serve a one-year term as president elect followed by a two-year term as president, ending with a one-year term as past-president. **Sharon Cutler Ross**, '65, has been elected the Association's second VP. Ross teaches mathematics at DeKalb College in Atlanta, Ga. Kreider has been an MAA member for 31 years and Ross has been a member for 21.

XX APPLIED BIOLOGICAL SCIENCES

Jorge L. Sintes, PhD '78, writes: "I am currently associate director of Advanced Technology-Oral, at Colgate Palmolive Co.'s Technology Center in Piscataway, in New Jersey. I am manager of a department in charge of development of new products and technologies for professional use." . . . **Aaron L. Brody**, '51, PhD '57, is now the managing director and partner of Rubbright Brody, Inc.



A.L. Brody

According to a company news release, "The countless honors [Brody] has received from his peers in the Institute of Food Technologists and Institute of Packaging Professionals attest to his accomplishments, ability, and integrity. Brody brings to us over 20 years of hands-on industry managerial experience and more than 10 years of consulting." The company will conduct market and business research, strategic planning, venture and acquisition analysis, and opportunity identification, emphasizing food and food packaging. Brody was technologist on the development of microwave food heating and is the inventor of controlled atmosphere food preservation as well as one of the aseptic packaging systems. From 1981 to the present, **Susan Kathleen Alfano Van Der Vynck**, SM '73, has been working with

UNESCO in Paris. She is a program specialist responsible for the design and execution of UNESCO's programs in nutrition, health, and home economics education, including the development of training and instructional materials for formal and non-formal education programs. She is also responsible for the supervision and management of country field projects in nutrition, health, and home economics. She is responsible for interagency cooperation in nutrition and health and is the representative to the U.N. Administration Committee on Coordination and Subcommittee on Nutrition. She is editor of the UNESCO Nutrition Education Series. . . . The Alumni/ae Association has been notified that **Elsie P. Arnold**, SM '65, of Richmond, Ontario, died on February 25, 1991. She was employed in Canada's Health and Welfare Toxicology Evaluation Division. There was no further information provided.

XXI HUMANITIES

Thomas S. Kuhn, professor emeritus of philosophy at MIT, has been awarded an honorary degree conferred at a special convocation at the University of Chicago last September in celebration of the university's centennial. Kuhn was recognized for his writings and for "his ground-breaking contributions to understanding the ways in which various scientific views are supported and discounted over time." . . . **Jeanne Bamberger**, professor of music at MIT, has recently completed *The Mind Behind the Musical Ear: How Children Develop Musical Intelligence* (Harvard University Press, 1991). According to the book's jacket, "By emphasizing the idea that each 'hearing' of musical composition is a 'performance,' one among many possible hearings, Bamberger suggests that there are different ways of constructing meaning and that the processes of perception and conceptualization are reciprocal."

XXII NUCLEAR ENGINEERING

Martin Zimmermann, SM '89, sends word: "I am currently working as a research associate at the Institute of Robotics at the ETH in Zurich, Switzerland, where I am in charge of the design for the control system of a combined wheeled and legged robot with insect-like intelligence. Besides, I am heavily involved in teaching students and working on a new course on 'Designing Smart Mechatronic Products.' Most important, my wife, Petra, and I are the proud parents of our first daughter, Pia Andrea." . . . From San Jose, Calif., **W. H. D'Ardenne**, PhD '64, writes: "I have been elected chair of the Nuclear Power Plant Standards Committee of the American Nuclear Society." . . . **Joseph W. Synan**, SM '69, NUE '69, is founder and president of Leadingwell Associates, a leadership and team excellence consulting practice in Houston. . . . **H. Keith Roe**, SM '74, NUE '74, has added the title of chair to those of president, CEO, of Burns & Roe, Inc., in Oradell, N.J.

STS PROGRAM IN SCIENCE, TECHNOLOGY & SOCIETY

Professor **Leo Marx** gave the Lowe Lecture at Macalester College in Saint Paul, Minn., in mid-October. The talk was entitled "On the Grace of Nature: The Religious Aspect of Literary Pastoralism in America." . . . Professor **Eugene Skolnikoff**, '49 (VI), SM '50 (VI), PhD '65 (XVII), reported to the October MIT Faculty meeting on the study he chaired last year on the subject of MIT's international relationships. . . . Professor **Sherry Turkle** was a featured speaker at the "MIT

Symposium on Kids and Computers" in late September. She delivered the keynote address for the Conference on Cultural Issues in Psycholanalytic Theory in New York in early October. . . . **Jessica Wang** and **Bruce Bimber**, STS graduate students, shared the first Siegel Prize for their essay on the relationship of science and technology to political events in the U.S. The prize was established in memory of Benjamin M. Siegel, '38, PhD '40, a pioneer in electron microscopy and until his death in 1990, professor emeritus of applied engineering and physics at Cornell. Wang's essay recounted the security problems of the scientist E.U. Condon during the loyalty investigations of the McCarthy period. Bimber's essay dealt with the development, philosophy, and politics of the Office of Technology Assessment. . . . **Barbara Masi**, '86 (II), SM '88, **Wade Roush**, and **Ken White** presented papers on "Boundaries and Paradigms in Artificial Intelligence Research" at the 45 meeting November 15 at the Cambridge Center Marriott.—Phyllis Klein, STS Program, MIT, Rm. E51-128, Cambridge, MA 02139.

Deceased

The following deaths have been reported to the Alumni/ae Association since the *Review* last went to press:

G. Hobart Stebbins, '17; September 26, 1991; Bellevue, Wash.
Henry R. Lacey, '18; March 13, 1991; Melbourne, Fla.
Webster W. Frymoyer, '21; October 5, 1991; Arlington Heights, Ill.
Eastman Smith, '22; September 18, 1991; Mountain Home, Ark.
Richard H. Frazier, '23; October 24, 1991; Winchester, Mass.
George H. Fuller, '25; May 30, 1991; Colonia, N.J.
Hyman Katz, '25; January 6, 1987; North Quincy, Mass.
Seward S. Merrell, '25; October 5, 1991; Saint Petersburg, Fla.
W. Alan Williamson, '26; September 19, 1991
Marion E. Knowles, '27; September 18, 1991; Akron, Ohio
Ralph W. Stober, '27; October 1, 1991; Newton Highlands, Mass.
Howard S. Root, '28; September 24, 1991; Harrington Sound, Bermuda

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Henry D. Addison, '30; October 10, 1991; Northampton, Mass.
Robert A. Lytle, '30; June 14, 1991; Grosse Point, Mich.
Watson E. Slabaugh, '30; August 31, 1991; Mansfield, Ohio
D. Malcolm Fleming, '33; August 12, 1991; Rockville Centre, N.Y.
Charles N. Debes, '35; August 31, 1991; Rockford, Ill.
Joseph K. Raes, '35; August 3, 1991; Las Vegas, Nev.
Albert J. Del Favero, '36; September 18, 1991; Vista, Calif.
O. William Muckenhirn, '37; September 2, 1991; Toledo, Ohio
Robert D. Williams, '37; September 17, 1991; Lake Helen, Fla.
Robert R. Chase, '39; January 12, 1991; Austin, Tex.
Joseph W. Harrison, '39; October 14, 1991; New London, N.H.
Charles A. Lawrence, '39; July 12, 1991; Seattle, Wash.
Edward A. Ruckner, '41; September 12, 1991; Annapolis, Md.
David G. Edwards, '42; December 29, 1990; Pacific Grove, Calif.
Anthony P. Barbato, '44; July 17, 1991; Kettering, Ohio
Warren H. Howard, '44; September 29, 1991; Sunapee, N.H.
Louis H. Roddis, Jr., '44; September 15, 1991; Charleston, S.C.
Henry F. Lloyd, '46; June 12, 1991; St. Augustine, Fla.
Wilton M. Fraser, '47; February 14, 1991; Naples, Fla.
C. Gregory Bassett, Jr., '48; September 25, 1991; Hilton Head Island, S.C.
Aubert L. Mowry, '48; March 16, 1991; Northridge, Calif.
Warren W. Houghton, '49; October 20, 1991; Manchester, Mass.
Philip A. Lynn, '49; October 29, 1991; Reading, Mass.
William B. Martz, '50; May 2, 1991; Winchester, Mass.
Douglas Porter, '50; June 10, 1991; Watertown, Mass.
Morgan L. Foster, '51; January 11, 1990; Meadville, Pa.
Peter Bishop, '54; September 29, 1991; Falmouth, Maine
Francisco Torras, '54; October 3, 1991; Fairfield, Conn.
Joseph A. Kissinger, Jr., '55; June 1, 1990; La Habra, Va.
J. William A. Tyler, '55; February 1, 1990; Monroe, Ohio
John A. Welsh, '55; September 26, 1991; Richardson, Tex.
Herbert Curt Burrowes, Jr., '56; October 1, 1991; Concord, Mass.
Stanley L. Lopata, '56; October 9, 1991; Natick, Mass.
Charles V. Brown, '58; July 27, 1991; Bridge of Allan, Stirling, Scotland
Marvin H. Cantor, '59; May 16, 1991; Rockville, Md.
Irving Levinson, '61; February 26, 1991; Silver Spring, Md.
Frederik O. Jeppesen, '64; April 23, 1991; Denmark
Elsie P. Arnold, '65; February 25, 1991; Richmond, Ontario
George T. Onega, '70; March 23, 1990; Slidell, La.
Ronald G. Jackson, '71; June 1, 1991; Pymble, New South Wales, Australia
Daniel R. Siegel, '83; October 20, 1991; Wilmette, Ill.
Peter L. Armstrong, '84; August 27, 1991; Waban, Mass.

PUZZLE CORNER

Continued from Page MIT 39

If $1991 = m^2 - n^2 = (m+n)(m-n)$, then either we have $m+n=1991$, with $m-n=1$; or we have $m+n=181$ with $m-n=11$. This gives $m=996$, $n=995$ in the first case; $m=96$, $n=85$ in the second. The resulting triangles are our fourth and fifth solutions: (1982040, 1991, 1982041) and (16320, 1991, 16441).

OCT 3. That famous riverboat gambler, Bob High, was inspired by 1989 JUL 5 to ask a two-part question about shuffling cards. First, in a shuffled deck, what is the average (expected) number of cards occupying their original position? (This is to ask, for $n = 52$, what is the average number of fixed points of a permutation of n things.) Second, which is more likely in a random shuffle (permutation) of n things: exactly one fixed point, or exactly none?

Gordon Rice has a fine analytic proof, a copy of which can be obtained from Faith Hruby at *Technology Review*. Curiously, Rice was in the process of formulating a similar problem when he read OCT 3. The following shorter solution is from John Chandler, who believes he might be a 25-year veteran as a reader of "Puzzle Corner."

Consider any specific card. After a randomizing shuffle, its chance of being in its original position is simply $1/52$. Obviously, the posteriori probability of a second card being in "its" original position will depend on the actual position of the first card. Still, there is no preferred treatment of any of the cards, so the overall expectation of cards remaining in position after the shuffle must be just $52 \times 1/52 = 1$. For $n < 52$, this is easily proven by enumeration of all the permutations of n things. Moreover, it is simple to write down recursion formulas for the count of permutations with a given number of fixed points in terms of the counts for smaller n . For example, $N(n,1) = N(n-1,0) \cdot n$, $N(n,2) = N(n-2,0) \cdot n \cdot (n-1) / 2$, and so on. The table begins:

	n =	0	1	2	3	4	5	6	7
f=0		1	0	1	2	9	44	265	1854
1			1	0	3	8	45	264	1855
2				1	0	6	20	135	924
3					1	0	10	40	315
4						1	0	15	70
5							1	0	21
6								1	0
7									1

This suggests a further formula: $N(n,0) = N(n,1) + (-1)^n$, and that can, in fact, be proved by induction. The answer to the second question is, thus, that exactly one fixed point is (slightly) more probable if n is odd and exactly none if n is even.

Better Late Than Never

OCT 5D. Dan Drucker notes a typo: S should be $(D-1)/2$ not $(D+1)/2$.

Other Responders

Responses have also been received from Matthew Fountain, Coe Wadelin, Mayer Wantman, Frank Carbin, Winslow Hartford, John Woolston, Eric Lund, Jim Landau, Ken Rosato, Steven Feldman, Rolph Person, William Waite, Ronnie Haige, Eugene Sard, Max Hailperin, Warren Jasper, Scott Berhenblit, Avi Ornstein, Thomas Lewis, Alan Priot.

Proposer's Solution to Speed Problem

Because a plank's constant.

Objet Dart

This June is my class's 25th reunion and I was asked to write a page of "Puzzle Corner" for the book they are producing. In preparing for the column I reread the introductions from the first seven years of "Puzzle Corner" and I must confess that it was fun to escape back to those earlier, more carefree days. I found some of my old words touching, some boring, and occasionally some were quite surprising. I guess we really do change. If any of you have little vignettes of your past life stored away, I recommend that, when no one else is looking, you take some private time with your former self.

Problems

F/M 1. Dave Wachsman sent us a hand he played (as South) with his wife that was reported in Truscott's column in the *New York Times*.

North			
♠	82		
♥	A72		
♦	Q75		
♣	KQ942		
West		East	
♠	973	♠	65
♥	J865	♥	104
♦	KJ1032	♦	984
♣	J	♣	A108653
South			
♠	A K Q J 10 4		
♥	K Q 9 3		
♦	A 6		
♣	7		

Both sides were vulnerable. The bidding:

South	West	North	East
1 ♠	Pass	2 ♣	Pass
3 ♠	Pass	3 N.T.	Pass
4 ♥	Pass	4 N.T.	Pass
6 ♠	Pass	Pass	Pass

How does Mr. Wachsman bring home the slam after West leads the club jack?



SEND PROBLEMS, SOLUTIONS, AND COMMENTS TO ALLAN J. GOTTLIEB, '67, THE COURANT INSTITUTE, NEW YORK UNIVERSITY, 251 MERCER ST., NEW YORK, N.Y. 10012, OR TO: GOTTLIEB@NYU.EDU

F/M 2. John Prussing believes that the following puzzle, which was actually on the 1989 Putnam exam, seems about right for "Puzzle Corner."

A dart hits a square dartboard. If any two points on the dartboard have the same probability of being hit, what is the probability that the dart will land nearer to the center of the board than it does to an edge?

F/M 3. Our last problem is from my NYU colleague, Dennis Shasha, and can be found in his book, *The Puzzling Adventures of Dr. Ecco*.

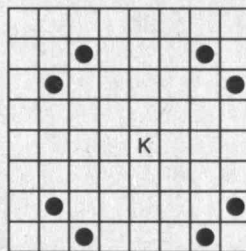
You are given 20 coins. Some are fake and some are real. If a coin is real, it weighs between 11 and 11.1 grams. If it is fake, it weighs between 10.6 and 10.7 grams. You are allowed 15 weighings on a scale (not a balance). You are to determine which coins are real and which are fake.

Speed Department

Speedy Jim Landau wants to know why the Kindom of Metrica chose to use a long, flat piece of wood as their Royal Standard of Length.

Solutions

OCT 1. We start with a chess problem (which may well be a computer problem) from Victor Barocas. It is well known that a knight can tour the chess board, touching each square once and only once, and beginning and ending on the same square. Consider now the generalized knight $K(m,n)$, $m \leq n$, which moves m spaces along one axis of the board and n spaces along the other (the normal knight is $K(1,2)$; also see diagram). For what values of m and n can the knight tour the board?



Moves available to $K(2,3)$ at position e4.

The following solution is from Ken Kiesel: Each time the knight moves one space in either direction, it moves to a square of the opposite color. Therefore, $m + n$ must be odd, or the knight can reach only squares of one color.

A knight on one of the four center squares can move a maximum distance of 4.4. Thus, the possible solutions are 0,1 0,3 1,2 1,4 2,3 and 3,4.

$K(0,1)$ is the only solution besides $K(1,2)$, unless there is a bug in my program. $K(0,3)$ obviously doesn't work.

Each corner square is accessible to only 2 squares. Therefore, one of these squares must be used to enter the corner, and the other to exit it. For $K(3,4)$, diagonally opposite corners reach the same 2 squares; therefore it cannot tour the board. This leaves only $K(1,4)$ and $K(2,3)$.

The program I wrote found a solution to $K(1,2)$ in about 7 seconds on my XT clone. It eliminated $K(2,3)$ in less than that. In fact, $K(2,3)$ can be shown not to work quite easily. Starting at a8, the possible first moves are to c5 or d6. Since the two are equivalent, choose d6. If the second move is not to g8, g8 will be left with only one accessible square, f5. It will be impossible to enter and exit it later. Therefore, the second move must be to g8. The only possible third move is to f5. If the fourth move is not to h7, then it will have only one entry square, f4. But if it is to h7, then b7 will have only one entry square, c4.

With two rapid results from the program, plus a test of the trivial $K(0,1)$ and $K(0,3)$ to further verify program operation, I launched it on $K(1,4)$. It finished after about 80 hours, having found no solution.

OCT 2. Gordon Rice wonders how many Pythagorean triangles you can find in which one of the three sides is 1991.

The following is from Jerry Grossman, who has secret plans involving this problem:

There are five Pythagorean triangles one of whose sides is 1991: (10860,1991,11041), (1980,209,1991), (180180,1991,180191), (1982040,1991,1982041), and (16320,1991,16441). The "easiest" way to learn this is by asking a computer algebra package to solve (in integers) $x^2 + y^2 = 1991^2$ and $u^2 + 1991^2 = v^2$. I asked Maple and it gave me these answers. Here is how to do it more or less by hand:

Since $1991 = 11 \cdot 181$, we can look for three kinds of solutions: primitive solutions (i.e., no common factor to the three sides) in which one side is 1991, solutions in which one side is 11 (and then multiply all sides by 181 to obtain the desired triangle), and solutions in which one side is 181 (then multiply by 11).

The fundamental fact we need to use is that all primitive triangles are of the form $(2mn, m^2 - n^2, m^2 + n^2)$, where m and n are relatively prime positive integers.

Let's start with the solutions in which one side is 11. Clearly $2mn$ cannot equal 11, nor can $m^2 + n^2$. So the only possibility here is that $m = 6$ and $n = 5$, giving us the triangle (60,11,61), and hence the solution to the original problem (60,11,61)*181 = (10860,1991,11041).

Next we look for solutions in which one side is 181. Again we cannot have $181 = 2mn$, but we can have $181 = m^2 + n^2$, with $m = 10$ and $n = 9$ (this is the only way). This gives a triangle (180,19,181), yielding the second solution (1980,209,1991). We can also have $181 = m^2 - n^2$, only by letting $m = 91$ and $n = 90$. This gives us the triangle (16380,181,16381), and hence our third solution (180180,1991,180191).

Finally we look for primitive solutions with one side being 1991. Again, 1991 is not $2mn$. A computer search shows that 1991 cannot equal $m^2 + n^2$.

Continued on Page MIT 38

MIT LIFE INCOME FUNDS

MR. AND MRS. WALTER S. WOJTCZAK

HOME: Newbury, New Hampshire;
Sarasota, Florida

CAREER: Mr. Wojtczak, CE '37, gives his MIT connections credit for helping him find his first three jobs in the construction industry. He started out as an office engineer for the construction of large buildings, such as schools, office buildings and churches, and went on to become a project engineer and then a project manager in charge of all outside work. In 1950, he joined Standard Builders, Inc., of Hartford, Connecticut, and while with them managed the construction of buildings for the Aetna Life Insurance Company, Connecticut General, Connecticut Mutual, Trinity College, United Technologies and the University of Hartford, among many others. He retired in 1985 as senior vice president.

Mr. Wojtczak is past president of the MIT Club of New Haven and is now president of the MIT Club of Southwest Florida. He has served on the Alumni Fund Board, the Alumni Association Board of Directors and, from 1946 to 1981, on the Educational Council. He and Mrs. Wojtczak, who met in the summer of 1932 and married in 1940, have two children and two grandchildren.

GIFT OF CAPITAL: Walter S. Wojtczak (1937) Fund in the Karl T. Compton Pooled Income Fund.

QUOTE: Somebody subsidized about 50% of my education and I feel I have an obligation help today's students. The Karl T. Compton Fund gives us what is equivalent to an annuity, supplementing my income during my retirement. It is especially good for people who don't have strong pension programs or who are reluctant to make large outright gifts because of the loss of income that entails.

For more information about gifts of capital, write or call Frank H. McGrory or D. Hugh Darden at MIT, 77 Massachusetts Avenue, Room 4-234, Cambridge, Massachusetts 02139-4307; (617) 253-3827.

Photo: Richard Howard



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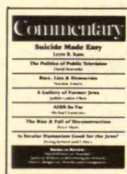
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To protect workers, Congress should strengthen the Occupational Safety and Health Administration and force the agency to wield its powers more aggressively.



Keeping OSHA's Feet to the Fire

By CHARLES NOBLE

ALMOST as soon as the Occupational Safety and Health Administration was established in 1970, conservatives made this Department of Labor agency their favorite symbol of what was wrong with big government. According to the critics, OSHA had something to say about everything, no matter how trivial, from the placement of exit signs to the design of stepladders. In 1981, Reagan administration deregulators singled out the agency for special attention. In the years that followed, OSHA, never an especially effective advocate of worker health and safety, dramatically slowed the rate at which it set workplace standards and sharply cut back its enforcement of the Occupational Safety and Health Act.

Today OSHA makes it into the news now and then—typically after a major accident, such as the 1991 fire that killed 25 workers at the Imperial Food Products

poultry-processing plant in North Carolina. But for most people, most of the time, the agency has slipped from view. The result is that U.S. workers can no longer look to the federal government to be an effective advocate for their safety and health.

Work, however, remains dangerous. Although accidental worker deaths have declined since 1970, 10,000 people still die on the job each year. Every day another 11,000 workers are injured seriously enough that they lose work time or have to restrict their work activity. The lost-workday rate is actually climbing, up 65 percent between 1972 and 1989.

Perhaps most disturbing, Americans remain unprotected from most toxic chemicals common in today's workplaces. Between 1,000 and 3,000 new substances appear every year. Many are toxic, some are lethal, and the vast majority are unregulated by OSHA. As a result, in addition to accidental deaths, occupational diseases kill a substantial number of workers. According to the Office of Technology Assessment (OTA), the most common estimate is 100,000 such deaths yearly, but because information is crude and monitoring primitive, no one knows how prevalent occupational diseases really are. OTA notes that estimates range from 10,000 to 210,000 deaths each year.

These depressing statistics raise hard questions about federal regulation of working conditions. After 21 years in business, it is time to ask how well OSHA fulfills its mission and what the U.S. can do to make occupational safety and health regulation more effective.

Too Few Standards

OSHA has two major functions—standard setting and enforcement—and it does neither well.

OSHA has been remarkably reticent to establish standards, particularly for exposure to toxic substances. To be sure, more than 700 standards are on the books, but only 30 are comprehensive health rules—like the standards for lead and benzene—that set permissible exposure levels and require employers to monitor worker exposure and its impact on worker health. A recently revised air-contaminant standard sets exposure levels for 630 toxic substances, such as chloroform, carbon monoxide, and trichloroethylene, but it fails to require exposure monitoring, employee medical surveillance, or the precautionary transfer of workers who may be especially susceptible to particular hazards. Many health and safety professionals question whether these “threshold limit values” (TLVs), based on the recommendations of the American Council of Governmental Industrial Hygienists (ACGIH), adequately protect workers. In a recent article in the *Ameri-*

can Journal of Industrial Medicine, Barry Castleman and Grace Ziem charge that corporate representatives wield undue influence in ACGIH deliberations, so that many of its standards fail to recommend strict enough exposure levels.

Even with the new air standards, OSHA rules cover only a small percentage of the toxic substances threatening workers. The agency has set control levels for only 121 of 526 carcinogens identified by the ACGIH, the International Agency for Research on Cancer, the National Toxicology Program, and the National Cancer Institute's Cancer Bioassay Program.

Significant gaps remain for safety standards as well. Many existing standards are outdated. The certification and training procedures specified in the crane safety rule, for example, are much too weak. Many known safety hazards, such as repetitive-motion injuries and work in confined spaces such as furnaces, railroad tank cars, and sewers, are only partially regulated or completely unaddressed.

Why does OSHA do such a poor job? Many factors constrain the agency, but at bottom the reasons are economic and political: cost-conscious corporations have urged government to keep OSHA under wraps, and for most of the agency's 21 years they've succeeded.

This is not to deny that many managers want to do the right thing, and that many companies are responsible and even innovative in this area. However, complying with health and safety standards can be very expensive. The OTA estimates that capital spending on worker health and safety was about \$5 billion a year in the mid-1980s. Particular firms and industries can be hit especially hard. To protect workers from cancer and respiratory infections, the formaldehyde standard was reduced in 1987 from 3 parts per million to 1 ppm, a move that cost a number of industries from plastics to wood products \$60.5 million initially and \$28.3 million each year since. A pending cadmium standard, designed to protect metal workers from cancer and kidney damage, could cost \$160 million annually. Both these standards have met strong corporate resistance.

Even during the Carter presidency, when Eula Bingham, a strong defender of worker rights, ran OSHA, the agency had to wage a constant and often losing battle against efforts to keep the lid on regulatory agencies. Under the fiercely pro-business Reagan administration, budgets were cut, standards were withdrawn, and enforcement was sharply curtailed. Most disturbing, employers appear to have enjoyed special access to the White House staffers charged with evaluating OSHA policies. The Office of Management and Budget (OMB) used unprecedented authority to review regulations to repeatedly delay or kill proposed OSHA rules. For example, after comments by OMB, OSHA revised or withdrew rules requiring employers to maintain employee medical and exposure records and to inform employees of the risks they faced. At the same time, the White House sent its lawyers to the Supreme Court to

CHARLES NOBLE is a professor of political science at California State University, Long Beach. He is the author of *Liberalism at Work: The Rise and Fall of OSHA* (Temple University Press, 1986).

support industry challenges to the economic feasibility of the lead and cotton dust standards. Both standards survived judicial scrutiny, but the message was clear: the Reagan White House was more interested in protecting employers from OSHA than workers from hazards.

By the mid-1980s, standard setting had slowed to a crawl. A final formaldehyde rule took 6 years to issue; the short-term exposure level for ethylene oxide, a widely used sterilant in hospitals, required 7 years. It took 2 years to finalize a rule designed to protect workers when equipment that should be shut down accidentally operates—a rule that OSHA expects will prevent some 120 deaths and 60,000 injuries annually.

OSHA's stance on standards improved somewhat under Gerard Scannell, the recently resigned OSHA administrator. He readily acknowledged the need to speed up the rule-making process and attempted to depoliticize the agency. But in practice, too little changed. Apart from the 1989 air contaminant standards, the pace of rule making remains glacial. An enormous number of long-pending rules, like that for a lead standard in the construction industry that would protect workers who renovate and demolish old bridges and houses, are still in limbo.



Too Little Enforcement

Even if OSHA filled the Federal Register with standards, too many workers would go unprotected because enforcement is too limited. For example, about 2,150 inspectors at the federal and state levels combined—including 300 federal supervisors and trainees—are responsible for 5.9 million work sites. Only 11 percent of U.S. employees benefit from regular safety inspections. A mere 3 percent of U.S. workplaces are inspected annually.

Money is part of the problem. OSHA's budgets have always been too small, and in the last decade the agency's funding dropped 10 percent in real dollars while the number of employers covered by the Occupational Safety and Health Act rose by almost a third. Many OSHA-approved state agencies that join it in enforcing the law are underfunded as well, and are likely to remain so in this era of government fiscal crisis. For example, the North Carolina agency responsible for inspecting Imperial Food Products has fewer than 20 safety inspectors to cover 150,000 workplaces.

OSHA tries to deal with its resource constraints by focusing almost all investigations on the most dangerous industries, such as construction, oil and gas extrac-

*Between 1,000 and 3,000
new substances appear in
the workplace every year.
Many are toxic, some are
lethal, and the vast majority
are unregulated by OSHA.*

tion, and maritime operations, as well as the most dangerous manufacturing establishments. This strategy exempts most sites from regular inspections. Even with targeting, OSHA inspectors see fewer than one in ten high-hazard jobs sites and one in five workers in high-hazard establishments in any given year. With so small an inspectorate and so many targets, the ability to deter violations is severely limited.

Even an employer that is inspected and found to be violating OSHA rules is unlikely to feel significant pain.

Fines are simply too low to matter to most companies. Until Congress revised the penalty structure in 1990, the maximum allowable fine for a violation likely to result in physical harm was \$1,000; it was \$10,000 for willful or repeated violations. Actual penalties have been far lower: in 1986, the Department of Labor reported that the average fine for a serious violation was \$208.

OSHA did embark on a more aggressive enforcement policy in the mid-1980s, and the number of cited violations and total amount of penalties rose significantly. The average penalty for a serious violation rose to \$261 in 1988, and to \$365 in 1990.

In a more important step forward, in 1986 OSHA began citing each instance of a hazardous condition as a separate violation when the agency judges employer actions to be reckless and irresponsible. Headline-grabbing "megafines" have resulted. OSHA fined two Caterpillar plants a total of \$1,064,000 for failing to properly record fractures, burns, lacerations, respiratory diseases, and repetitive-motion injuries. After a 1989 explosion in a refinery in Pasadena, Tex., Phillips Petroleum was fined \$5.7 million for safety violations. IBP received a \$5.7 million fine and USX a record \$7.3 million fine for record-keeping and safety violations.

This aggressiveness is an important breakthrough, but megafines are the exception, not the rule. From 1986 through March 1991, OSHA handled only 100 of 300,000 citations in this way. Moreover, negotiations with employers have reduced the fines to an average of one-third the initial amount, according to Congress's General Accounting Office. For example, IBP's fine dropped 83 percent to \$975,000.

In 1990, Congress boosted most maximum fines sevenfold and established a \$5,000 minimum for willful violations, yet OSHA seems reluctant to use its new powers: the Department of Labor has called them a "discretionary upper limit only." Instructions issued to



*Too many standards, like those
for cadmium and formaldehyde,
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remained exposed.*

field personnel in March 1991 suggest a maximum \$5,000 fine for violations that can cause serious injury, rather than the \$7,000 maximum specified in the law. The instructions also encourage agency representatives to consider a host of mitigating factors from the size of a firm to its financial condition.

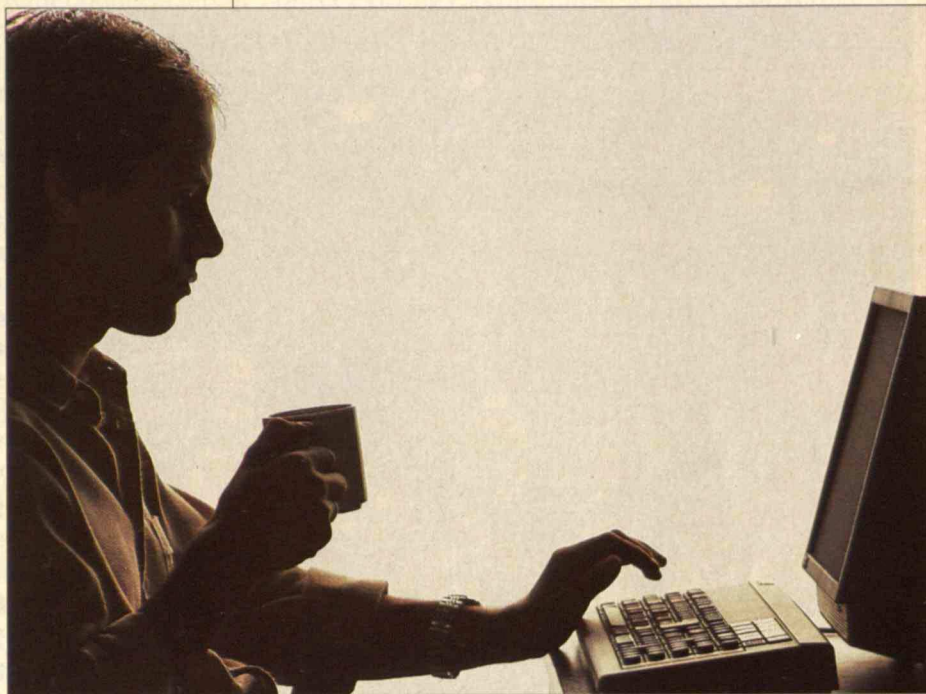
OSHA officials maintain that hard-line enforcement is unnecessary and counterproductive. It's unnecessary, they argue, because safety pays: safe workplaces are more productive, and employers who protect their staff reap the benefits of lower workers' compensation premiums. According to this view, government has a role to play but not as an adversary. Rather, OSHA should provide employers with research, training, and information and help coordinate private-sector health and safety efforts. A hard line is counterproductive, says former OSHA administrator Scannell, because heavy citations will cause a backlash and firms will more often challenge the agency in court, complicating and delaying enforcement efforts.

These arguments don't always hold up. Worker training, engineering controls, monitoring, and health and safety education can cost a lot of money, and it's hard for an individual firm to capture the economic benefits that might flow from such efforts. In particular, many occupational diseases such as cancer have long latency periods, and workers change jobs too often to easily link specific toxic exposures to specific illnesses. Since it's difficult to assign responsibility for a disease, the rational employer, however enlightened, will think twice about a substantial, voluntary investment in protection.

It is not surprising, then, that major gaps exist in employer compliance with OSHA standards. Companies routinely test for lead (used in battery manufacturing, construction, foundries, and other industries) and for silica (also used in construction and foundries), but research indicates that from one-third to one-half the companies inspected exceed OSHA standards for these two hazards. These same studies suggest that the record is probably even worse for the hundreds of regulated substances for which neither OSHA nor industry effectively monitors workplace exposures (although comprehensive data on compliance are obviously lacking).

Reforming the Standard-Setting Process

The record is not entirely bleak. Taken seriously, regulation makes a difference. As the OTA has pointed out in the case of vinyl chloride, lead, and cot-



Even an employer found to be violating OSHA rules is unlikely to feel significant pain. Fines are simply too low to matter to most companies.

ton dust—three instances in which OSHA set and enforced strict standards—occupational exposure has declined significantly. The number of workers exposed to illegal levels of cotton dust, for example, dropped by half in the first years after the standard was issued. And recent research by economist Wayne Gray of Clark University and political scientist John Scholz of the State University of New York at Stony Brook shows that injury rates significantly decline in plants that OSHA inspects and fines.

Several reforms would make it easier to replicate these successes. To begin with, OSHA can accelerate the standard-setting process. The agency must regulate recognized hazards faster, and it must quickly revise its standards as more becomes known about substances and processes already regulated. It is widely recognized, for example, that even low-level exposure to carbon monoxide aggravates heart disease and causes reproductive damage. Yet the current TLV is too high to protect the many workers, from forklift operators to welders, exposed to carbon monoxide. Fast-track revision would make sense here.

OSHA also needs to develop firm timetables for rule making and set priorities for that process. Too many proposed standards, like those for cadmium and formaldehyde, have taken too many years to appear while workers remain exposed to hazards. OSHA should also respond directly to recommendations from other agencies. These range from the National Institute for Occupational Safety and Health (NIOSH) and the

Environmental Protection Agency to OSHA's own advisory groups and interested private parties, including labor unions. At present, OSHA is free to ignore this advice. It usually does: while NIOSH has recommended specific exposure limits for over 125 chemicals, OSHA has acted on only a few.

Where feasible, OSHA should adopt "generic" regulations—across-the-board rules covering related problems or imposing a generally applicable remedy. Candidates for generic standards include groups of chemicals with similar properties, such as workplace solvents, and work practices that apply broadly, such as monitoring exposure to toxic chemicals and educating workers about dangers.

Standard setting would also improve if workers could more easily seek court review for OSHA's failure to act, just as employers who protest regulations seek judicial relief. OSHA inaction can now be litigated only



Regulation can make a difference. When OSHA set and enforced strict standards for vinyl chloride, lead, and cotton dust, occupational exposure declined significantly.

if the agency flagrantly violates its statutory responsibility under the Occupational Safety and Health Act. Some agency discretion is necessary and desirable, but if OSHA abuses its discretion, those who desire timely standards should have ready recourse to the courts.

Another needed step is to strengthen the responsibilities, status, and funding of NIOSH. Congress created this branch of the National Institutes of Health to play a lead role in researching workplace hazards and furnishing OSHA with "criteria documents" indicating safe levels of exposure to hazards. But NIOSH budgets are woefully inadequate; they have decreased 38 percent since 1980 and are lower in real terms than they were at NIOSH's inception in 1971. OSHA should be forced to take NIOSH recommendations seriously—and to state on the record, and if necessary defend in court, its reasons for rejecting them.

Finally, the Office of Management and Budget has been a major obstacle. Under Executive Order 12291, OSHA must prove to OMB that health standards are economically feasible and that the agency has chosen the most inexpensive method of compliance. While these criteria seem reasonable, they are highly subjective. Precise information is hard to come by and, as Morton Corn, OSHA head under Gerald Ford, has said, one can "almost derive any desired answer" from cost-benefit analysis by manipulating assumptions. During the Reagan administration, a debate between OSHA and OMB resulted in three significantly different cost-benefit analyses for the Hazard Communication Standard, which requires employers to provide workers with information about potential dangers. Each was credible but none definitive.

To ensure that the review process isn't used to protect those with political influence, the role of economic considerations in OSHA standard setting needs clarifying. The courts have ruled that regulations must be technically viable and must not bankrupt entire industries. In the benzene case, the Supreme Court insisted that a regulated health hazard must pose a significant risk and that a standard must improve worker health and safety. But Executive Order 12291 goes considerably beyond these criteria by imposing cost-benefit tests on agency rules. Congress should insist that given sound, scientific evidence that substances or processes threaten a significant number of workers' lives, industry must do what it can to protect them. Corporate profitability shouldn't trump worker health and safety.

Toward Effective Enforcement

On the enforcement side, regulation depends on the credibility of OSHA's powers of deterrence. Firms that expose employees to serious hazards must expect to be inspected and fined, and the fines have to hurt.

Even if its enforcement budget isn't sharply increased, OSHA can still target inspections more effectively on firms that expose workers to serious health dangers.

Though the agency tries to focus enforcement on high-hazard industries, it hasn't been particularly successful. A large part of the problem is that OSHA relies on surveys by the Bureau of Labor Statistics that identify high-hazard industries, not high-hazard establishments. Better data do exist: employers keep logs of injuries and accidents, but they don't have to send them to OSHA. Nor are firms required to monitor employee exposure to most biological and environmental hazards. To enable it to better target inspections, the agency should collect existing establishment-level data directly from employers and require them to monitor employee exposures to a wide variety of regulated toxic substances. To ensure that employer reports are accurate, NIOSH could expand its independent efforts to collect data on occupational diseases.

OSHA also should stiffen penalties substantially. Former administrator Scannell argues that many employers would fiercely resist this, and it is indeed likely that higher penalties would initially lead to more contested cases and delays. Over time, however, employers would accept the new reality and adjust to it. But today employers view OSHA penalties as little more than an annoyance, a cost of doing business. Congress has taken a necessary first step by raising maximum penalties; now OSHA has to wield these powers.

Finally, Congress needs to strengthen the Occupational Safety and Health Act's criminal penalties, and when employers recklessly endanger the lives of workers, OSHA should ask the Justice Department to file criminal charges. Specifically, Congress should give government the authority to seek felony charges against any employer who knowingly and willfully exposes a worker to the risk of serious bodily injury.

The act's criminal provisions are now too weak, providing only for misdemeanor prosecutions. Moreover, the Justice Department can file criminal charges only if an employer's willful violation of an OSHA standard kills a worker. Even then, the maximum fine is just \$10,000 and six months in jail. In contrast, violators of the Resource Conservation and Recovery Act of 1976, governing hazardous wastes, can be imprisoned for five years for putting a person in imminent danger of serious bodily harm.

Again, OSHA has been reluctant to use even the criminal powers it does have. In its first 18 years, it recommended 57 cases to the Department of Justice for prosecution. Over the same period, the Mine Safety and Health Administration, whose jurisdiction covers only 354,000 miners, pursued 460 criminal investigations. OSHA did pick up the pace in 1989: Scannell's first two years in office set a record for criminal investigations with 24 referrals to the Justice Department, a third of the agency's total referrals since 1971. That's still not enough, which is a major reason why some state and local prosecutors have stepped into the breach, charging employers with battery, reckless homicide, and involuntary manslaughter.

In *People v. Film Recovery Systems, Inc.*, Illinois' Cook County successfully prosecuted the president, plant manager, and foreman of a company that had knowingly exposed its employees to acute cyanide poisoning. All three managers, convicted of murder, received 25-year jail sentences. California prosecuted more than 280 cases between 1973 and 1988, and it recently passed a law that allows prosecutors to file felony charges against managers who expose employees to a serious concealed hazard.

Still, enforcement is OSHA's job. It has the expertise, and, used deftly, criminal prosecutions would substantially strengthen its hand. For several years, Congress has considered bills to increase jail time for willful violations causing death, and to specify criminal sanctions for willful violations causing serious bodily injury. Legislation before Congress includes these provisions. OSHA should make it clear to Congress that it supports such proposals and would vigorously enforce them.

The Right to Act

These reforms would make OSHA more effective, but even an aggressive, powerful, and well-funded OSHA wouldn't be enough for the task at hand. The U.S. economy is so large, complex, and diverse that it is impossible to imagine that any agency could send enough people into the field to identify every serious workplace hazard. An effective regulatory program will have to look elsewhere to maintain comprehensive coverage.

In fact, there is an alternative approach that might simultaneously keep OSHA's feet to the fire, address its resource constraints, and provide effective shop-floor enforcement of the Occupational Safety and Health Act: involvement of the workers themselves. If this nation is seriously committed to cleaning up its workplaces, employees will have to actively participate in decision making about working conditions. The federal government can substantially strengthen the role of all rank-and-file workers by mandating that firms establish employee-run safety and health committees, and by requiring that these be an integral part of efforts to maintain occupational safety and health.

Proponents call this the "Right to Act." Workplace committees would investigate accidents, inspect job sites, perform routine health monitoring, settle disputes, respond to imminent dangers, and even correct hazardous situations. Members would be selected by employees and trained in government-approved programs. Ideally, the workers and managers who serve on the committees would cooperate with public-health professionals, academic specialists in workplace safety and health, and environmental groups interested in broader health and safety issues, thereby linking workers, managers, OSHA, and the wider community.

Empowering workers with the Right to Act has several virtues. Besides advising management, the committees could aid and supplement OSHA's enforcement

tasks. The government could take advantage of the number, concern, and expertise of the people directly threatened by hazards. Industry would benefit as well, since people who are well informed about workplace hazards, carefully trained to handle toxic substances, and regularly consulted about working conditions are less likely to be injured. They are also more likely to help employers identify hazardous conditions and develop appropriate remedies.

Workers already enjoy some version of the Right to Act in Australia, Austria, Canada, Germany, and Sweden. To be sure, in the U.S. context, the Right to Act is a radical idea. But several laws and programs in the United States already take tentative steps in this direction.

On paper, workers already have a version of the Right to Act: the Occupational Safety and Health Act calls for their active participation, and many firms have labor-management health and safety committees. In practice, however, few employees have effective power over working conditions. Workers participate in only 17 percent of OSHA inspections. And while existing labor-management health and safety committees raise awareness about hazards, give workers access to information, and facilitate hazard monitoring and employee training, their power, and therefore their impact, is usually limited.

Federal and state right-to-know laws also establish the right of employees to be fully informed about workplace conditions. OSHA's Hazard Communication Standard requires manufacturers and employers to compile an inventory of chemicals used in a plant. The standard further requires employers to list potentially hazardous chemicals, label containers with chemical names, and provide a Material Safety Data Sheet that indicates the acute and long-term hazards, safe work practices, and emergency procedures for each substance. OSHA also requires employers to keep most medical and chemical exposure records for at least 30 years, and gives workers the right to examine illness and injury logs and summaries, see their exposure and medical records, and obtain information on toxic substances to which they have been exposed.

Finally, the Supreme Court has ruled that employees have a qualified right to refuse hazardous tasks. An employer can't retaliate against a person who refuses an assignment when there is reason to believe a real threat of death or serious injury exists and there is too little time to eliminate the problem by any other method. In other words, endangered workers need not passively wait for OSHA inspectors to arrive or accept the safety decisions of managers.

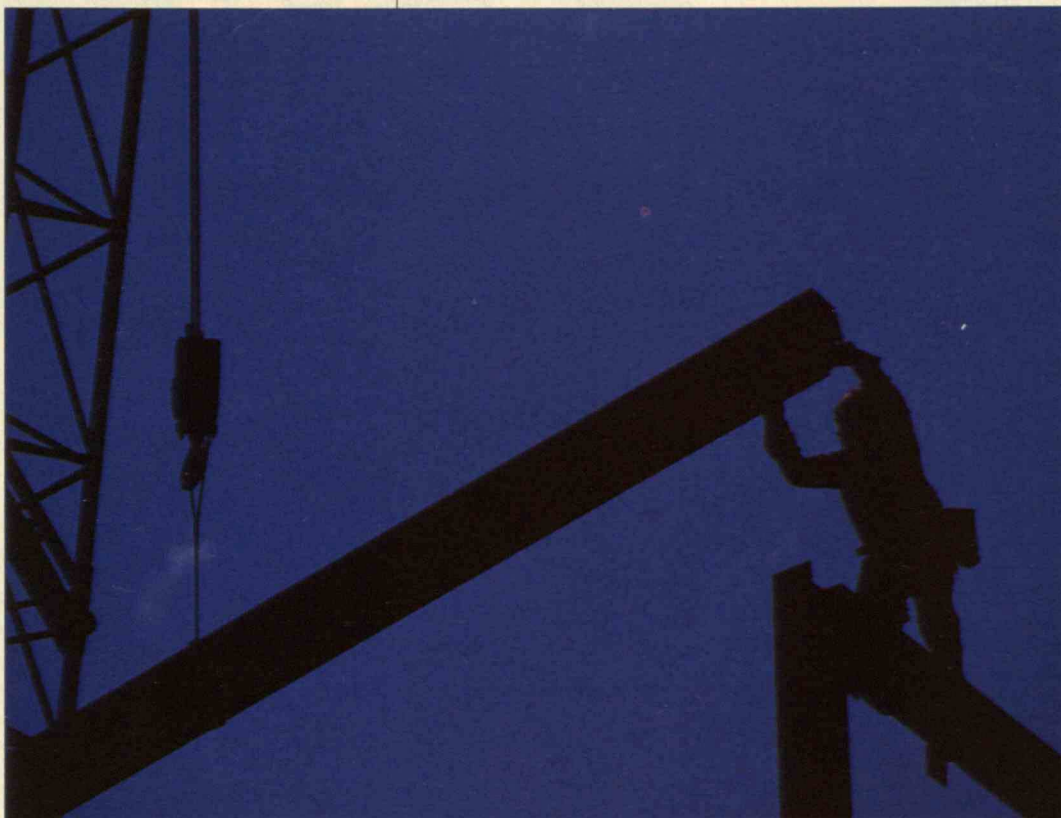
Meanwhile, liberal Democrats in Congress are pushing for further reform. Sen. Edward Kennedy (D-Mass.), Sen. Howard Metzenbaum (D-Ohio), Rep. William Ford (D-Mich.), and Rep. Joseph Gaydos (D-Pa.) recently introduced a comprehensive bill that would strengthen standard-setting procedures, impose criminal penalties for willful violations resulting in seri-

ous injury, and increase criminal penalties for violations resulting in death. The bill would bolster protection for workers who report unsafe conditions and require OSHA to target inspections on high-hazard industries.

Most important, the Kennedy-Ford-Metzenbaum-Gaydos bill would mandate worker involvement in shop-floor health and safety activities. All worksites with 11 or more employees would have to set up health and safety committees, establish safety programs, and educate workers about job hazards. Consisting of equal numbers of workers and managers, the committees would be empowered to review a firm's safety program and inspect its workplace.

While Congress is unlikely to pass any major workplace health and safety legislation this session, a variety of sources have shown signs of support for workplace reform. Even at deregulation's height, a 1981 Harris Poll revealed that two-thirds of Americans opposed sharp cuts in OSHA enforcement. Since then, one after another highly respected, nonpartisan organization has criticized OSHA's lethargy. For example, in its comprehensive 1985 government study, the OTA concluded that OSHA standards lag far behind professional recommendations and leave major hazards unaddressed. A 1987 report to the Administrative Conference of the United States, a federal agency, pointed to the "debilitating constraints" on OSHA, while a 1990 General Accounting Office inquiry suggested comprehensive reforms, including "enhancing standard setting, increasing deterrence, and improving hazard-abatement procedures."

Even OSHA recognizes that something must be done. Scannell proposed administrative changes to expedite standard setting and enhance enforcement. But his plans were far too modest—he opposed, for example, heightened criminal penalties and mandated safety and health committees. Reformers interested in more effective regulation will therefore need to look once again to the legislature, as they did in 1970. ■



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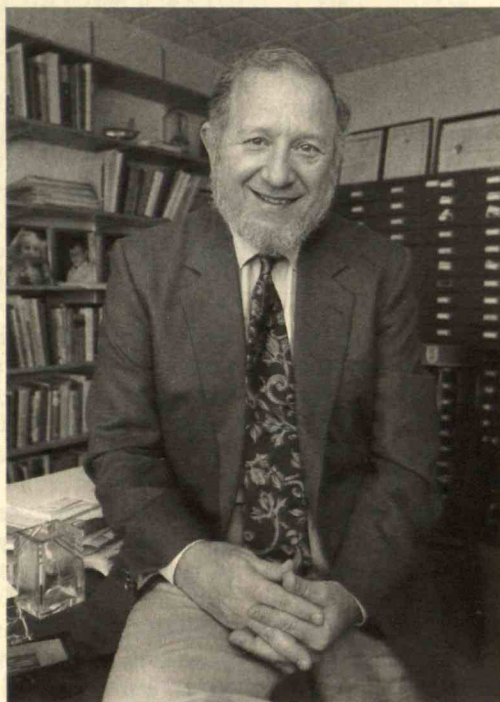
How to Succeed in Business

An Interview with Edward B. Roberts

The business press never tires of anecdotal tales about fortunes gained and fortunes lost by the legendary wheeler-dealers of Route 128 and Silicon Valley. But such stories add little to our understanding of technology entrepreneurship involving ordinary mortals. Who are the hundreds of engineers who strike out on their own each year? What is their work experience, their educational background, their motivation for leaving a good job for the uncertain path of starting a company? How much money do they consume—and where do they get it?

Into this vacuum steps Edward B. Roberts, David Sarnoff Professor of Management of Technology at MIT's Sloan School of Management. Roberts, who published his first paper on the subject in 1967, has distilled his quarter-century of research into a recent book, *Entrepreneurs in High Technology* (Oxford University Press, 1991). The book explores the origins and growth of hundreds of technology companies in the Boston area, many of which can trace their lineage to such local institutions as Harvard and MIT.

A talk with Roberts requires leaving



your preconceptions about entrepreneurship at the door. You thought that high-tech entrepreneurship entailed high risk? In reality, he says, few companies fail. You thought money was a serious impediment to starting a technology company? Most engineers do it on a surprisingly meager budget. You thought new ventures required the steady hand of one strong-willed founder? Companies with multiple founders enjoy by far the best shot at success.

Among other such insights, Roberts explains why shortcomings in the education of engineers may be the most serious barrier to the transfer of technology from the laboratory to the marketplace, whether at an existing company or a new one.

Roberts arrived at MIT in 1953 and earned four degrees there over the next nine years, including an SM in electrical engineering and a PhD in economics, and he has remained on the faculty ever since. But if Roberts is a scholar of entrepreneurship, he is not one whose view is confined to what he can survey from his window on Memorial Drive. He is a company founder and venture capitalist in his own right,

High-tech entrepreneurship counts as much on "the soft stuff" as on money and engineering skills.

having started Pugh-Roberts Associates, an international management consulting firm; Medical Information Technology; and Zero Stage and First Stage Capital Equity Funds, which invest seed money in new technology ventures.

Roberts was interviewed at his home in the Boston area by Stephen D. Solomon, a business editor and writer.

TR: Your studies appear to contradict the widely held perception that technology-based entrepreneurship is very risky and that most companies die quickly.

ROBERTS: They do contradict it. The failure rate among nontechnical companies—retail stores, for example—is as high as 90 percent in their first two to three years. But the failure rate of technology-based companies is relatively low. In general, our studies found that less than 30 percent of them go out of business during their first five years of existence. And in the first year, just 10 or 15 percent. Some more will go out of business in later years, but most will survive.

TR: What accounts for such a high survival rate?

ROBERTS: Many of these technology startups sell technical services, and they're formed by individuals who are looking more for independence than for further achievement. R&D contractors or consulting firms, for example, are often selling the skills and capabilities of their founders. Unless these people are really out of it, or unless their skills have suddenly become obsolete, there's a very good chance that they'll be able to continue selling those capabilities.

So they usually survive. And if they do close down, it's often out of choice. The founders realize that running a company is not the life they thought it would be—that it's just too much of a hassle.

Most of the technology startups that fail are those that try to make a commercial product. These companies need a lot of resources—for manufacturing, materials, distribution, sales, inventory support. Therefore they have to raise a lot of money, and they may lose that ability down the road if they haven't built a self-sustaining enterprise.

But these are the companies most likely to become great successes, too. A firm that makes a product is poised to grow much faster than one that performs contract R&D. However, its probability of success is only about 1 out of 3.

TR: What about the large percentage of com-

panies that are neither great successes nor outright failures?

ROBERTS: You have a fairly large group that I call "the living dead."

TR: Companies that are barely surviving?

ROBERTS: Yes, but they can often go on as long as their founders wish to persist. That can be until somebody comes along and makes an offer, or until the investors or venture capitalists decide they have to get out. But it's likely that the founders themselves will not turn out to be losers. Few will have put in more than \$10,000 or \$20,000.

Team Spirit

TR: What is it that makes companies started by teams more likely to be successful than companies started by single founders?

ROBERTS: First, we've found that single-founder entrepreneurs are likely to have a greater desire for power. They need to be in control and are therefore less likely to effectively motivate and manage other people. Second, multiple entrepreneurs bring in additional money. Third and most important, team members will likely have complementary skills. All the new technology companies have at least one technical person, usually an engineer, but with a larger team there is greater probability that one of the co-founders will have marketing or sales experience.

TR: But you often see companies started by a group of engineers without any such background.

ROBERTS: Even then, larger teams spend a greater proportion of time on the marketing, sales, and financial issues that tend to be ignored in single-founder firms. With technical design and development covered, you've created slack that can be allocated to other things.

Companies that have marketing orientations very early in their lifetimes enjoy a much greater success rate. The fact that you start with somebody who thinks in terms of customers, sales channels, marketing approaches, and pricing—as opposed to the uninformed way in which typical engineers approach business—makes a dramatic difference later on.

When single founders do have the marketing and financial skills that are so important in a technology startup, they're likely to do better than their single-founder compatriots who don't have those skills but are still unlikely to do better than a good team.



Though their attitude is beginning to change, engineers still regard people in management schools as irrelevant or stereotypically crass.

TR: But a team also seems to guarantee plenty of fights down the road. It's well known that there are often horrendous battles among partners.

ROBERTS: Teams will allow more room for creative contribution, but more room for conflict, too. So there's a good chance that the team will break up. Not the company, just the team. For example, if a company has five founders, it's likely that one will be gone within two years. But four will be left. You do see fights among founders, but they usually aren't terminal.

A Little Respect for Marketing

TR: It's surprising, given the pressure from the marketplace and from financiers, that entrepreneurs would overlook marketing functions. You pointed out in your book that only 40 percent of the business plans you studied contained a marketing strategy, and only 25 percent of the time did they attempt to identify competitors.

ROBERTS: It's not surprising to me. The founders were taught in engineering school that technology alone will win. Never were they taught anything about markets.

TR: Is that changing?

ROBERTS: I don't think so. Technology has economic value only in its commercial manifestations. But the narrow perspective of engineering education is that the advancement of technology itself is what one wants to pursue. I can give you a good example. A very distinguished MIT professor ran a major center in the engineering school in which he was trying to help engineering undergraduates bring technology to market. He lectured that if you build a better mousetrap, the market will beat a path to your door. That was one of his favorite sayings, which is not only old but patently wrong.

By the way, this problem is not unique to MIT. You take virtually any engineering school in the United States and look at the connections between the engineering departments and the management schools. You'll find such relationships to be either nonexistent or bad. And the intolerance is unidirectional—it is the engineers who often regard the people in the management school as irrelevant or stereotypically crass.

The result is that we leave to their experience, or their gut, or their boss the task of teaching technical people a different perspective. Not only were they never taught market-

When the entrepreneur gets sucked into the Type A mode of striving, "personal partnerships" start to weaken.



ing, they were in fact told that this discipline—being “soft stuff,” a lot of malarkey—is perfectly okay to ignore.

TR: Given these attitudes, why would engineering educators suddenly incorporate marketing into their curricula?

ROBERTS: Because it will help them produce better engineers who’ll be asking an additional set of questions in their work. They’ll be asking about customers, about need, about satisfaction, which will ultimately improve their technical work. By the way, some of this attitude problem is beginning to change at MIT. Closer ties are being established between the engineering and management schools as a result of programs like Management of Technology and Leaders for Manufacturing.

Other People’s Money

TR: If technology entrepreneurs don’t appreciate the marketing challenges inherent in a new

business, they do respect the financial hurdles to starting a company. Yet another of the surprising findings from your research is that most technology-based companies are started on modest amounts of money.

ROBERTS: Trivial amounts, really.

TR: Some 23 percent of the companies you studied were started with \$1,000 or less, and about half with \$10,000 or less.

ROBERTS: And inflation seems to have had very little effect, because the nominal dollars required to get going have remained fairly constant. People are actually putting in less, in real terms, than they did 10 years ago.

TR: How do technology entrepreneurs get by on so little?

ROBERTS: You don’t always have to purchase the equipment you need. You may already own it, or you borrow, or you use somebody

else's. My studies show that half the companies get started while the founders are still working full time for their old companies. If I'm trying to design some new device, what do I need money for? If I need computer-aided design time, there's a good likelihood I can bootleg that time at work.

This arrangement also takes care of salaries—founders usually don't need money to pay themselves for work on their new venture. My data showed not only that half of all technology entrepreneurs moonlighted, but also that the moonlighting period was often extensive—the average was nine months, and in some cases as long as two or three years.

Founders can also get technical help without paying cash. Technicians moonlight too, working without pay for some equity in the company.

TR: Are founders at this stage investing their own money?

ROBERTS: They are investing their own savings or the savings of their family and friends—say, for materials. That's good for the first \$1,000 to \$10,000.

TR: Eventually, they need more money than that.

ROBERTS: When entrepreneurs reach the point of having to make and market a product, they begin to invest in people and equipment. Then the capital demands are typically greater than they can satisfy from their personal savings. The next step is to look in their community for wealthy individuals, so-called "angels," who invest in startup companies.

These people have an informal network: they know each other, they've done deals together, they refer entrepreneurs to each other. Only a few of these angels are needed to together put up between \$50,000 and \$300,000, and occasionally as much as \$1 million.

TR: What about institutional sources of capital?

ROBERTS: That includes investments made through venture capital funds, public offerings, commercial banks, and large nonfinancial corporations. They represent an important source of financing—particularly in cases where the demand for capital is greater than even the angels can provide—for some 20 to 30 percent of companies.

TR: It's got to be much harder these days to raise that money.

ROBERTS: Today you'll find people telling

you that they can't get off the ground, which usually means that they can't go from a founding stage to a growing stage because they can't find the necessary capital. The recession has had a negative impact. Four years ago, we had \$4 billion in new money flowing into venture capital. This year it will be \$1 billion. Relatives, friends, and the angels are tighter, too. Not that they don't have the money; it's just that they don't want to take the risk. They see the economy as shaky. The uncle who could give you the first \$50,000 is more skeptical about giving you the second \$50,000 because he sees more and more business failures.

All in the Family

TR: Besides withstanding financial pressures, you've found that entrepreneurs pay a high price in the sacrifices they make in their family life.

ROBERTS: Entrepreneurs end up with a lot of marital problems. They start off quite differently, with their spouses totally behind them. In fact, it's characteristic of a company startup that spouses help wherever they can.

What happens in most cases, however, is that after the operation gets under way, the spouse's role diminishes. If the spouse was the accountant/bookkeeper, which is a popular role, someone else takes it over when the job gets more demanding. Now the "personal partnership" starts to weaken. The entrepreneur is driven by the demands of the business to put in large amounts of time—not just working, but working away from home. When the company started, the entrepreneur might have been moonlighting at home, so he or she could work down in the basement. There was no separation. Now there's a physical separation.

TR: If founders see the demands of the business ruining their family life, why don't they do something about it?

ROBERTS: They sometimes see it happening, but the business has become the command center. It demands their time, and they don't see an alternative.

TR: And are there any alternatives?

ROBERTS: Sure. Turn over some responsibility to other people. But that's tough to do. The entrepreneur gets sucked into the Type A mode of striving, believing that "I'm almost there; I could reach that goal if I just do another two things."

TR: Today those long-suffering spouses are likely to have careers of their own. Has the phenomenon of dual-income households changed any of the dynamics of entrepreneurship?

ROBERTS: Because a husband or wife can depend upon the other for financial support, it ought to be easier for one of a couple to take a significant risk of no income for an extended period. In the past, the wife used to support the husband from a weaker position—say, as a teacher or a secretary. Now, either one can be a high-powered professional, and the family will have a better cash flow while the company is started. That's a strong, encouraging force.

Overcoming History

TR: If family income is taken care of by a working spouse, why don't you see more start-ups among people in their forties and fifties? Your studies show that the median age of the technology entrepreneur in the Boston area is 34, and that few are past 40.

ROBERTS: I think that lifestyle changes have taken place by the time you're in your forties—you're usually set in your ways. And you want to marshal whatever financial resources you have for your kids' college education, or your aged parents, or your own retirement.

TR: But the financial risk is minimal, as you've said.

ROBERTS: If you're a mover and shaker, you've attained significant responsibility in some company by your forties. Do you now want to risk that position to start a company? Many potential entrepreneurs say no.

TR: What about women starting high-tech firms?

ROBERTS: In technology entrepreneurship, women still unfortunately aren't there. Sandy Kurtzig is the founder of ASK Computer. That company is, I think, the largest technically oriented firm in the United States founded by a woman. As a role model she's terrific, but who's second? I don't know.

Women have penetrated the engineering field, but almost entirely at the bottom. Most of them are young, and as they get older, many quit to become mothers and deal with family life. Thus they aren't lasting 10 to 14 years, which would be, according to our data, the point at which a successful engineer might be saying, "Now it's time to get the hell out of here and do my own thing."

TR: But surely a good many female engineers

choose not to have babies and remain as career-oriented as their male counterparts.

ROBERTS: If so, they are not showing up in the statistics as technology entrepreneurs. It may be that women who might go this route are deterred by what they perceive to be an old-boy network that excludes them from the financial links they need in order to get started on their own.

TR: What about minorities?

ROBERTS: The main thing impeding blacks would have to be home life. My data show very strong evidence of what I call the entrepreneurial heritage. If you come from a home in which your father was in business for himself, there is a much greater likelihood you will be in business for yourself, too. Blacks in the United States often come from homes in which the father was not present, and even when he was, he generally wasn't self-employed or an entrepreneur. So I think that blacks have a history to overcome, and it will be a long time before they show up strongly in the entrepreneurial group. It's probably also true, although I don't have the studies to prove it, that those blacks who aspire to become technology entrepreneurs face racial bias that makes it much more difficult to obtain capital and to win the trust of potential backers.

TR: Are there many blacks now in engineering schools?

ROBERTS: Their numbers are minuscule. With the decline in public education in the cities, many are not getting the quality of education at the high-school level to prepare them for engineering. And many find themselves attracted by other careers, such as law and medicine.

What Makes People Run

TR: Starting one's own business has been a path of upward mobility for many groups in our society. But although a successful entrepreneur can accumulate significant wealth, you've found that money was the primary motivation for less than 15 percent of the entrepreneurs you studied.

ROBERTS: If they start an R&D operation or a technology consulting company, entrepreneurs are usually motivated by the idea of becoming their own boss. But if they start a firm to manufacture a commercial product, then they're motivated by a need to achieve. They're looking for a challenge. They may be frustrated that they couldn't have done exactly



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the same thing for the company they used to work for. So it may be they want to do something "significant"—meaning that they want to put their name on something.

TR: I bet those people are among the company's best performers.

ROBERTS: Yes. In one study we found that the entrepreneurs who left major laboratories and started companies dramatically outproduced, on all the conventional measures of technical productivity, the people who stayed in the organization. The ones who left published far more papers, and—a much more significant indicator of commercial thrust—they had been issued far more patents.

This says to me that when a company loses people to entrepreneurship, it is losing its best people. And if there's something negative happening in the company that is forcing or encouraging such "spinout," then it will lose those really good people even faster.

For example, we studied a big Route 128 company that had gone through a good deal of turmoil. Most of its spinoffs took place during the periods of greatest layoffs and chaos at the firm, and yet none of the actual people who set up the companies had been laid off. They just came to realize that it was no longer the company that they had initially gone to work for. The values, attitudes, orientation, excitement, and challenge it once had were diminishing or gone. Thus the chaos made entrepreneurs out of people who might otherwise have stayed put.

TR: What can a large company do to retain would-be entrepreneurs?

ROBERTS: The first question is whether the company really values the entrepreneurial employee. Typically, that person is very individualistic and perceived by management as not being a team player. If the company does value such people, then it must create avenues for them to express their ideas about new products to upper management. It should offer the time and the funds to enable them to pursue their ideas on company time. Some companies create a division for new ventures, but that has to be accompanied by an organizational commitment to maintain its funding over the years and to provide job security to those who join the division. All in all, everything the company does, from compensation to promotions, must confirm the idea that the corporate culture is one that rewards entrepreneurial individuals.

TR: Even in the most nurturing corporate cultures, some people will still want to strike out on their own. What advice would you give them?

ROBERTS: I would tell them not to start a company until the market says they can. They should use their skills not only to check out their ideas but also to test them in the marketplace. Is this a product or service that people are willing to buy? They shouldn't start a company, as so many engineers do, based on their egos. Finding out what the customer wants is more important than anything else. ■

The background is a deep blue gradient. On the left side, there are several abstract, three-dimensional geometric shapes. At the top left, a series of blue and black cones are arranged in a diagonal line. Below them are various polyhedrons in shades of yellow, orange, red, and purple. A large, flat green disc is positioned in the middle left. At the bottom left, a large, multi-pointed star-like shape in orange and yellow is visible. The overall aesthetic is reminiscent of early computer graphics or vector art.

Software's New

**OBJECT-ORIENTED
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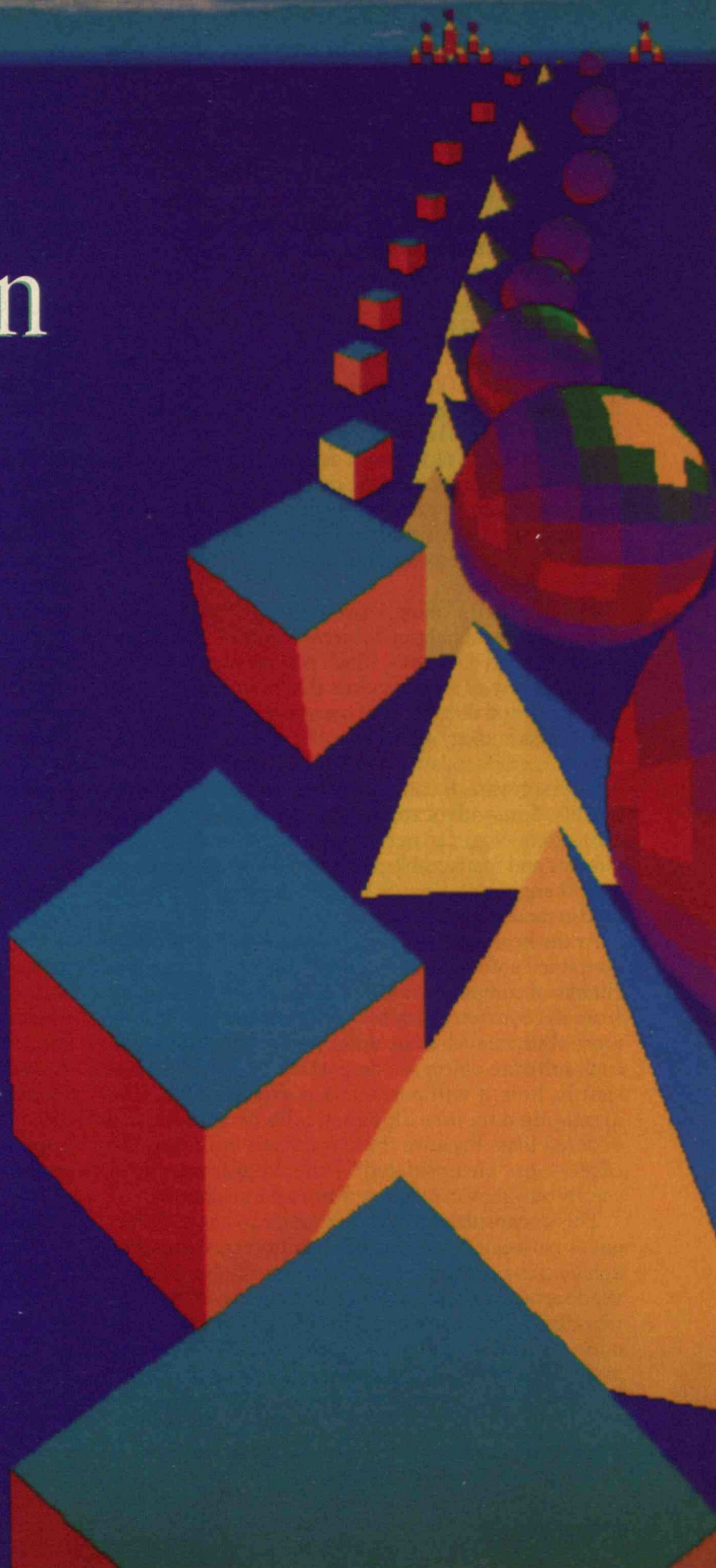
BY ROBERT HAAVIND

Object Lesson

Imagine if all cars had nonstandard engines that were built by hand. And imagine that each make of car needed its own special fuel, which had to be hand blended in a laboratory. In such a world, automobiles would probably play a much diminished role: fuel would be prohibitively expensive and hard to find, and the engines would be difficult to repair.

Computer users have come to accept such a bizarre situation as normal. Most software is still constructed piece by piece by highly trained craftsmen--a costly and inefficient practice reminiscent of the blacksmiths and wood-carvers of past cen-

ILLUSTRATIONS: STEPHEN ELSTON



turies. Software works only on the type of system it was written for and on compatible versions. And as programs are modified and expanded over time, they become so convoluted and complex that making any changes becomes nightmarishly difficult. The irrationality of the software industry becomes clearer by comparing it with the electronics business, where competing manufacturers long ago settled on standard connections and voltage levels, enabling designers to assemble systems using circuitry and equipment from multiple vendors.

Such problems have intensified with the tremendous growth of computing. Networks are linking desktop machines of all types, and users need to tap large databases residing on incompatible mainframes. Giant software packages may run an entire enterprise or even a whole business sector, such as airline reservations or the stock exchanges. And the quickening pace in many businesses requires more frequent programming changes. Yet today's software remains inflexible, and revisions to large programs often introduce subtle, intractable bugs.

Change is in the offing, however. The computer world is abuzz with talk about "object-oriented" languages, programs, and databases, which provide potential solutions to many of the difficulties that have long plagued both users and developers of computer systems. Object-oriented technology appears to offer, at last, a convenient way to interlink today's jumble of incompatible computers and software. It could also make programs easier to modify. Some advocates also believe that eventually, object technology can make software production a more efficient and manageable process by allowing the use of interchangeable software "parts" analogous to those used in modern manufacturing.

At the heart of object-oriented technology are self-contained software units called "objects." These are chunks of computer code that describe entities ranging from the concrete, such as an automobile part, to the more abstract, such as an airline reservation. Intrinsic to each software object is a description of its behavior—that is, how it will perform a particular task, like arranging data into alphabetically or numerically ordered lists. Because these traits are built into the object—or "encapsulated"—the programmer need specify only that an object perform a particular task.

This encapsulation makes it easier to cloak differences between incompatible computers. Instead of agreeing to make entire software systems compatible, vendors need only settle on a common way of sending messages to objects. It also allows software to be treated in a more modular fashion, with objects being assembled without regard for what is inside them. Modifying object-oriented software does not require

alteration of the objects themselves; instead, the programmer can design new objects that "inherit" attributes from similar existing ones.

Some proponents believe that object-oriented technology will eventually allow ordinary computer users to make their own programs out of pre-made software objects—with little or no programming experience. Just as it requires no electronics expertise to put together a stereo system from off-the-shelf audio components, so too might computer programs be easily assembled and tailored for individual taste. Because programs written with object techniques will be easier to upgrade, users will ultimately get higher quality products.

The road to an object-oriented world does have obstacles. Although an object-oriented system is more flexible and easier to change, it is also more difficult to develop. Because data and the instructions for manipulating it are "hidden" within each object, testing is difficult. And since programmers have been working with objects for only a few years, they have not yet accumulated the vast body of expertise that accompanies conventional programming methods. Partly because of this relative inexperience, some object-oriented programs tend to work more slowly than traditional software.

In many cases, object technology is being added on to existing software, either to help mask incompatibilities or to add a simpler graphic interface. The technology's greatest impact, however, will occur when whole software systems are built completely with object methods. Even so, many incompatible versions of object-oriented software could emerge, undermining the technology's promise of becoming a kind of computer Esperanto. Unless standards are established, therefore, the power of objects will not be fully realized.

The potential benefits of object-oriented software appear to outweigh these drawbacks, and so hardware and software makers are wasting no time in developing object-oriented products. IBM designed its highly successful line of mid-sized business computers, the AS/400 series to run with object-oriented code. Hewlett-Packard's New Wave software uses object-oriented techniques to allow PC users to link separate applications programs, even ones that reside on different systems. Borland International, a Santa Cruz, Calif., supplier of database programs for personal computers, now uses object-oriented techniques to write most of its software.

Microsoft is touting object-oriented features in its new version of the Windows operating system for IBM-compatible PCs. Thanks to the object-oriented software, says Microsoft chairman William Gates, it will be easy for programmers to add enhancements to a piece of software without modifying the main program. Gates says that Windows 3.1, due out later this year, will make it possible, for example, to add spoken comments to particular cells in a spreadsheet. And in perhaps the most

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dramatic development, object technology will be the foundation of IBM and Apple Computer's efforts to link their presently incompatible personal computer systems.

A New Way to Program

Object-oriented programming promises to bring some order to a chaotic software scene. Some 100 billion lines of computer code are in use today in the United States, according to estimates cited by management consulting firm Ernst & Young. These programs were developed over the past few decades at a cost of some \$2.3 trillion and cost an additional \$30 billion a year to maintain. Many massive software systems with hundreds of thousands of lines of code were well documented initially, but after hundreds of modifications and numerous personnel changeovers, it becomes difficult to fathom exactly how the program works, let alone make revisions and add new functions.

The appeal of object-oriented technology stems partly from the weaknesses of conventional software, in both its underlying structure and the methods that have evolved to develop it. Typically, system requirements are formulated and then analysts break the solution into a set of program modules. Skilled specialists tediously code, line by line, each module—a process reminiscent of pre-Industrial Revolution manufacturing. There's little reuse of previously coded subroutines that may perform similar functions, so, in effect, programmers are frequently reinventing the wheel. As work progresses, requirements may be altered and flaws may become apparent in the way the overall programming job has been divided up—but it is extremely difficult to go back and restructure modules once coding is well underway.

In conventional software, each program is built from “procedures,” or sequences of coded instructions. Typically, individual programmers or groups of programmers write separate modules, which then work together to perform the task the software is designed for. Each procedure within a module is instructed to operate on certain “data types” (such as calendar dates, dollars, or numbers with fixed or floating decimal points). If a new data type is introduced, a programmer must find and modify all the procedures that deal with it — a difficult and time-consuming task in a large software system with many loops and jumps.

Object-oriented software avoids these problems by combining in each object the programming procedures that define how an entity will behave as well as all the data related to that entity. Procedures, in object parlance, are called “methods.” A typical software object might be a simulation of a vehicle; the object's methods would determine, for example, how the car would start, turn, and stop. Objects communicate with each other via specially structured messages. A message, in an object-oriented program, might con-



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sist simply of the name of an object followed by the name of the method—for example, "car stop."

One powerful attribute of object-oriented software is that each object has built within it the knowledge for how to respond to a particular message. This allows the same message to be sent to many objects. A software "car" object, for example, would respond to a message of "turn left" much differently than would a software "motorcycle" object. Built into the simulated motorcycle would be the knowledge that a left turn requires leaning.

Probably the most important distinction of object-oriented software is the ability of objects to "inherit" behavior. Lower-level objects can incorporate the properties of more generic, higher-level objects. Thus programmers can devise hierarchies of objects, each assuming the traits of the object at the higher level. Construction of a "jet airplane" software object, for example, could begin by simply inheriting all the traits of an already defined "aircraft" object and then modifying it. Similarly, a "supersonic fighter" object would automatically assume all the characteristics of a "jet airplane." With conventional software, programmers must copy code—bugs and all—and then modify it. With objects, programmers copy the results of code. It's the difference between photocopying a document and abstracting its main idea.

Inheritance makes software easier to modify. To construct a computer model of a plastic-bodied car, for example, an auto designer would need only change a generic "body parts" object from steel to plastic and write new code to represent the material's different characteristics. The particular body-component objects, such as the "fender" object and the "door" object, would inherit these altered properties without additional reprogramming. In another example, a new airline could be added, with a minimum of fuss, to an object-oriented database program for managing airline reservations. The objects representing the new carrier would simply inherit the general format of price structures and schedules that had been previously defined for a generic "airline" object. The programmer would then have to reconcile only whatever minor differences there might be between the new airline and this generic object. With a conventional database, by contrast, such tasks would force the programmer to start from scratch, says Thomas M. Atwood, chairman of Object Design, a Burlington, Mass., company specializing in object-oriented software.

Toward an Object World

The movement toward object-oriented software appears likely to be an evolutionary migration. The first generation of such software, exemplified by Hewlett-Packard's New Wave, will mainly help users to interlink existing applications programs.

The second generation of object-oriented software

will allow people at many different locations and using a variety of computer types to work collaboratively. The object-oriented approach greatly aids such teamwork, allowing, say, geographically dispersed design engineers, manufacturing managers, and accountants to collaborate on bringing a new product to market. Such groups typically work on different computers running incompatible software. Object-oriented technology will help transcend these differences. Software developers will be able to devise "smart" applications that will, for example, automatically update all the participants' files based on pertinent results from the work of others.

Eventually, computer users as well as programmers will be able to customize and enhance their programs by selecting from libraries of well-tested software objects. A user of an investment-portfolio management program, for example, could add different types of rules to reflect changes in personal financial needs or in the general economic climate.

The fastest changeover to object-oriented technology is occurring in the software that engineers use to automate the design of complex electronic and mechanical systems. Traditionally, in computer-aided design, each engineer uses a set of specific software-based tools. Object-oriented frameworks will allow engineers to put together a suite of tools from different vendors. The object-oriented software will make it practical for each of these design tools to share a common graphical interface, making them easier to learn and to use. As designers work for hours on their section of an overall project, the object-oriented database will help keep tabs on any changes that might affect other sections. Moreover, object-oriented databases take some of the tedium out of designing. An electronics engineer, for example, could simply specify what task a circuit should perform; the object-oriented database will help translate this specification into a circuit design.

Another benefit Atwood claims for object-oriented systems is more compact code: he says his company's database management system contains some 250,000 lines of code programmed in an object-oriented language called C++. Three times that much code would be needed, he says, to write a comparable program in C, a conventional programming language that is used in about 80 percent of today's design-automation programming. The shift to an object-oriented model can also greatly reduce execution time—perhaps by three orders of magnitude, according to studies done by Sun Microsystems.

The changeover in business data processing will come more slowly, Atwood says, because present relational databases are well-suited to the file structures common to business applications. Object technology will be used instead to integrate the computer's underlying operations. IBM's AS/400, for example, uses the object approach to provide a simple graphic interface so that it can be run by relatively unskilled operators, even clerks, according to Roy A.

Bauer, a quality manager at IBM's Application Business Systems division in Rochester, Minn. Previous mid-sized computers have required specially trained personnel to run, Bauer says.

Avoiding Babel

Although touted as a means of overcoming computer incompatibility, object-oriented technology has the potential to exacerbate rather than solve the problem. The proliferation of software development efforts based on object-oriented technology is reminiscent of what has happened with UNIX, a family of operating systems used widely in science and engineering. As it gained popularity, UNIX spawned dozens of conflicting variations that only now are being folded into a standard system.

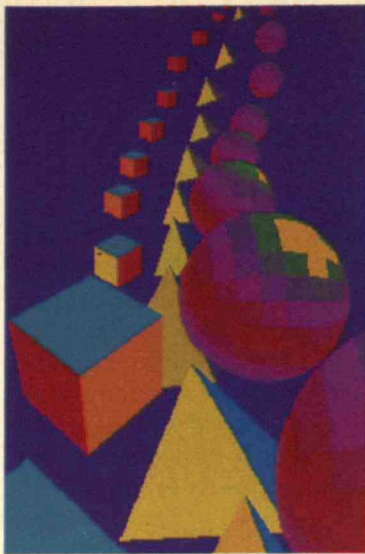
The potential for object-oriented technology to degenerate into yet another software Tower of Babel led to the formation in 1989 of the Object Management Group (OMG) in Framingham, Mass. More than 150 organizations have joined this standards-setting group, including such industry leaders as Microsoft, Apple, and IBM as well as Japanese and European companies.

OMG hopes to prevent the fledgling object-oriented software marketplace from following the familiar computer industry trajectory. The group intends to forge a consensus on standards for functions common to many types of software, such as exchanging objects over networks and gaining access to remote databases. OMG hopes to convince vendors that without such standardization, they will have a much more difficult time selling whatever object-oriented products they develop.

Critical to the success of this strategy is devising a standard way for objects to send and receive messages. The goal, explains OMG president Christopher M. Stone, is for objects to interact with each other regardless of how they were originally programmed. This interaction—which should be transparent to computer users—would permit sending electronic mail messages, extracting data for a chart, or swapping information with a distant collaborator using a different computer and software.

To achieve such smooth transactions, OMG's first priority is to establish a standard "object request broker," or ORB, which will act as a sort of traffic cop for interchanges across diverse networks and equipment. Getting the industry to agree to such standards is not easy, however. Already, two groups—one led by Hewlett-Packard and Sun Microsystems and the other by Digital Equipment Corp.—had to be pressed to merge different ORB proposals into a single submission.

Perhaps the most serious drawback to object-oriented software is cost. Some experts contend that it now can cost four or five times as much to design an object-oriented software system as a conventional one. This discrepancy should diminish as a commercial



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object-oriented market takes shape and programmers build complex software systems by lacing together reusable pieces of code, using powerful development tools now coming on the market.

Rationalizing the Software Business

By drastically simplifying the production of software, object-oriented technology could turn the software industry upside down. Ultimately, software could evolve into a commodity business, with users and programmers alike shopping for interchangeable software modules.

A leading proponent of this transformation is Brad J. Cox, president of Information Age Consulting in Washington, Conn. Cox points out that the costs of computer hardware have been declining rapidly while there have been only minor improvements in software costs. He sees the object-oriented approach as a way to turn software into a more rational industry, exhibiting the usual learning-curve cost reductions. Objects, he maintains, will turn software into a "manufacturing" business.

Cox uses the analogy of the rise of interchangeable parts in gun making to describe his vision for software evolution. In Revolutionary days, muskets were crafted individually by gunsmiths who embedded their names into each creation. Then, in 1798, Eli Whitney, the Connecticut inventor famous for his cotton gin, contracted with the government to build 4,000 muskets using interchangeable parts. Eight years later, Whitney delivered the muskets to the government and even then they weren't made from truly interchangeable parts. Indeed, not until 50 years later could guns be conveniently assembled; to make the process work, manufacturers had to develop inspection gauges to separate acceptable from unacceptable pieces.

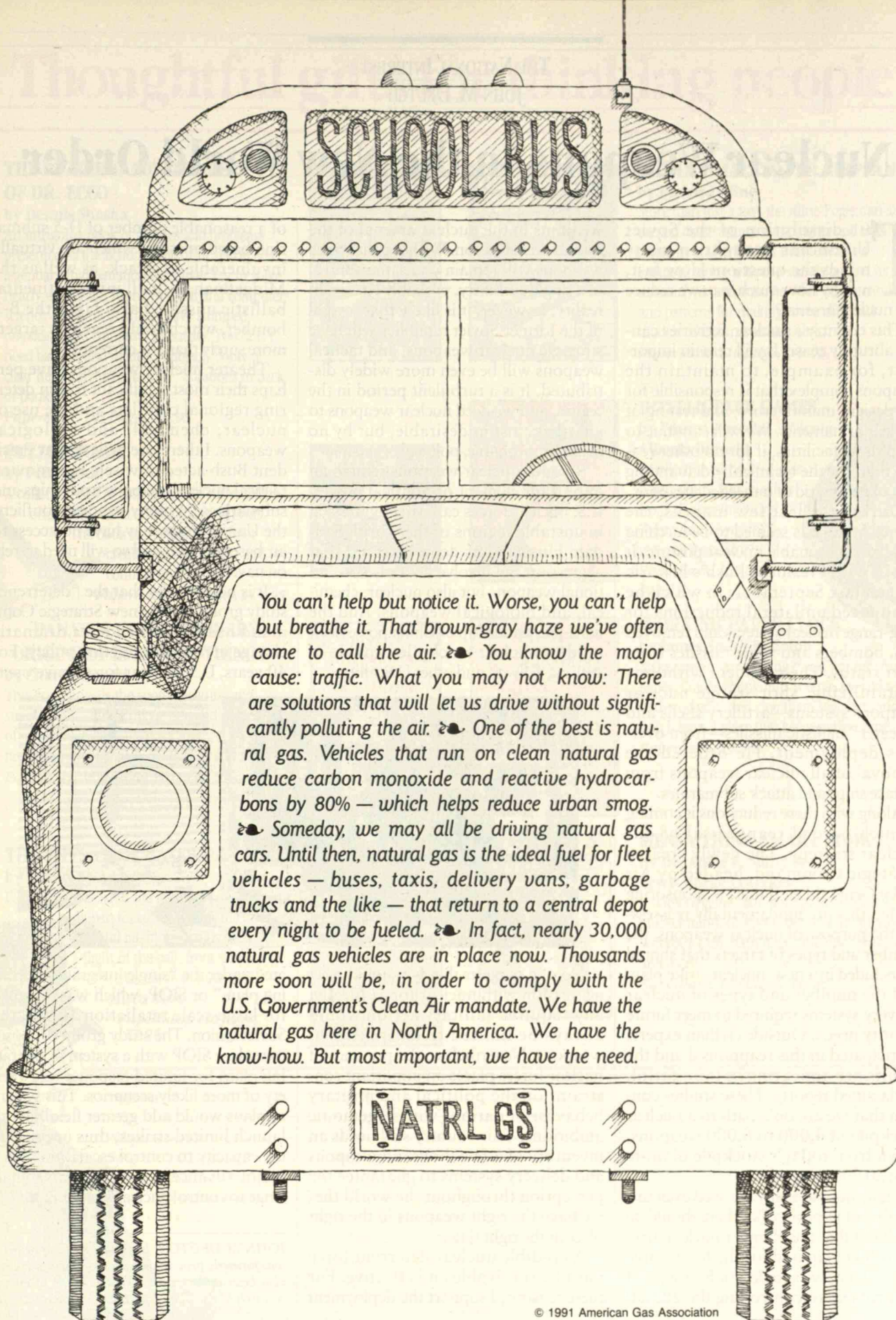
Analogous developments are necessary, Cox maintains, to transform the software industry. Computer programs should be assembled out of pre-manufactured, interchangeable parts. What's also needed is the software

analog of a pocket micrometer to assure that each manufactured programming object meets specifications within tolerances: Is the program fast enough? Does it do all the tasks expected of it, quickly enough? Does it consume an acceptably small amount of computer memory?

Cox envisions a software industry structured much differently than today's. Users would pick and choose software objects from a large network of vendors and assemble the objects into a system that meets their precise needs. Cox likens this to the electronics industry, where manufacturers buy integrated circuits (ICs) as commodities and then connect them in different and customized ways. He foresees an emerging market in "software ICs." Standards would ensure that objects sold by different companies would work together.

Other object-oriented specialists laud Cox's vision but stress that it is a long way from realization. "Cox is a little optimistic," says Richard Soley, vice-president and technical director of OMG. "Not everybody is going to be a tinkerer." Others, such as Adele Goldberg of ParcPlace Systems, which markets tools and generic objects for object-oriented programming languages, believe that market economics dictate against the software-IC approach. Selling small chunks of code to individual users who could assemble them into specialized programs would require a much too elaborate distribution system. Instead, Goldberg suggests, marketing tools and generic objects will serve developers of more general-purpose software packages.

Still, few would argue with the need to turn the software development process into a more efficient activity with more predictable results. Just as the automobile owes its low price and near ubiquity to mass production, so computer software will require a new method of production if it is to fulfill its promise as a source of universally available, easy-to-use information tools. After all, although there is still a place for handcrafted Rolls Royces, it was the mass-produced Model T that changed the world. ■



Nuclear Weapons in the New World Order

THE dissolution of the Soviet Union has brought to many minds the question: How fast, and by how much, can we reduce our nuclear arsenal?

This country's nuclear activities cannot abruptly cease. It will remain important, for example, to maintain the weapons complex that is responsible for the design, manufacture, and testing of nuclear armaments. We will continue to need these facilities, if for no other reason than for the technically demanding task of getting rid of unneeded weapons.

During the last few months, the United States has seemed to be lurching toward a reasonable nuclear posture. It began with President Bush's historic speech last September, in which he announced unilateral reductions for long-range nuclear systems and removed U.S. bombers and some missiles from alert status. The president withdrew destabilizing, short-range nuclear weapons systems—artillery shells and “theater” ballistic missiles—from overseas deployment. He ordered the removal of all nuclear weapons from surface ships and attack submarines.

Along with these reductions is coming a much needed reappraisal of our nuclear strategy. The newly created Strategic Command, headed by Air Force General Lee Butler, is sponsoring studies that are fundamentally reassessing the purpose of nuclear weapons, the number and types of targets that should be included in a new nuclear strike plan, and the number and types of nuclear delivery systems required to meet future security needs. Outside civilian experts participated in this reappraisal and the results are appearing in thoughtful, unclassified reports. These studies confirm that we are on a path to a nuclear stockpile of 4,000 to 6,000 weapons, down from today's stockpile of more than 20,000 weapons.

Many question why we need even this number of weapons. But there should be no doubt that this slimmer nuclear arsenal will be required for the foreseeable future. First, we should not lose sight of the problem of controlling the 20,000

weapons in the nuclear arsenal of the former Soviet Union. We hope that these weapons will remain under the control of a single authority, probably Russia. In reality, however, it is likely that several of the former Soviet republics will have strategic nuclear weapons, and tactical weapons will be even more widely distributed. It is a turbulent period in the region, and we need nuclear weapons to guard against undesirable, but by no means improbable, political events.

Second, nuclear weapons remain an important element of political power. U.S. nuclear forces can deter aggression in unstable regions of the world. Saddam Hussein has demonstrated that aggression can involve not only conventional weapons but also nuclear, chemical, and biological weapons. And the hard-line leadership of China possesses a modest nuclear stockpile capable of striking Taiwan and other U.S. allies.



No one suggests that we should meet aggression with nuclear force. Ideally, any required military action would always be limited to conventional weapons. Nevertheless, the presence of nuclear forces places an important constraint on the political and military behavior of nations with hegemonic ambitions. This country still needs an inventory of a few thousand weapons and delivery systems to guarantee the perception throughout the world that we have the right weapons in the right place at the right time.

A credible nuclear deterrent force must be survivable and effective. For these reasons, I support the deployment

of a reasonable number of D-5 submarine-based missiles, which are virtually invulnerable to attack, as well as the Midgetman, a small intercontinental ballistic missile. I also favor the B-2 bomber, which could reach its targets more surely than the current B-1.

Theater nuclear weapons have perhaps their most significant role in deterring regional conflicts and the use of nuclear, chemical, and biological weapons. I therefore believe that President Bush acted unwisely in removing tactical nuclear weapons from ships and submarines; in many regional conflicts, the United States may have no access to air bases on land and so will need to rely on naval forces.

It is noteworthy that the “deterrence study group” of the new Strategic Command has recommended a dramatic change in nuclear targeting policy. For 40 years, U.S. nuclear forces have oper-

ated under the “single integrated operating plan,” or SIOP, which was designed for large-scale retaliation against the Soviet Union. The study group proposes to replace SIOP with a system of operating plans for limited response to a variety of more likely scenarios. This system of plans would add greater flexibility to launch limited strikes, thus improving the capacity to control escalation. It is a major advance in the continuing challenge to control nuclear weapons. ■

JOHN M. DEUTCH, Institute Professor at MIT, was formerly provost and dean of science. He has also been undersecretary and director of energy research of the U.S. Department of Energy.

Demilitarizing Engineering Education

IT will soon be springtime on college campuses, when seniors in science and engineering begin looking for jobs. As they hand in their resumes, a placement counselor will inevitably ask: "Would you work for a defense contractor?" Now, more than ever before, the judicious graduate should answer, "No, thanks."

But the response cannot end there. With the thawing of the Cold War and the end of the bipolar arms race, the United States finds itself with an over-muscled military and a long list of domestic problems. As the country begins cutting back on military programs and seeking new resources, we should pay serious attention to the military's profound influence on higher education.

University engineering programs reflect Pentagon needs in both overt and subtle ways. At an East Coast engineering school, for example, students in an introductory design course recently were asked to design a naval cannon. Less obviously, students of virtually every technical discipline find themselves learning methods and solving problems that, although masked in abstract concepts and mathematical formulations, relate directly to the development of military systems. Much of what is taught as "state of the art" electronics, aeronautics, and industrial automation has its origins in Pentagon-funded projects.

A crucial link to the classroom has been the research conducted by science and engineering faculty, research lavishly sponsored by the Department of Defense and its industrial contractors. Engineering courses often reflect the knowledge garnered from these inquiries as well as their sponsors' underlying interests. Thus in a recent case, students were assigned to work on a model aircraft using their professors' research on strong, lightweight composite materials. While the aim of this Air Force-funded project was not to produce a fighter plane on campus, it was clear where both the research findings and the careers of the participants were headed.

Many engineering educators disagree with the assertion that what they teach is

essentially military. They argue that they merely teach bodies of knowledge and neutral problem-solving techniques that can be used anywhere. Their graduates are free to choose where and how to apply this learning. In fact, however, many of the basic premises at the heart of contemporary engineering education bear a distinctive military stamp. Implicit in many engineering syllabi and problems sets are the assumptions that:

- a person's work will be a small, narrowly circumscribed piece of an enormous system that one need not fully comprehend;
- the goals of technical work are fixed by dictates from on high and require no personal evaluation;
- human beings are sources of unreliability whose presence ought to be minimized; and
- the human consequences of engineers' work are not their concern.



Such notions reflect the requirements for designing large, complex systems for military command and control. When transferred to a domestic economy, these assumptions help spawn the rigid, overly complicated, unresponsive tendencies often lamented in U.S. industry today.

Engineering students have caught on to this military orientation, a perception buttressed by the fact that ROTC scholarships finance the education of tens of thousands of students in scientific and technical majors. Even those who do not wear uniforms to class are encouraged to take co-op and summer jobs with military contractors. Students in my classes return from these forays with tales of


glorious salaries, housing stipends, and company cars. No wonder the word has spread that "the good jobs" are in the defense industry.

Roughly one-third of U.S. scientists and engineers work for the Pentagon or its contractors. But military priorities are badly matched to the requirements of the global marketplace. Technical professionals must now exhibit personal qualities much different from those nurtured during the Cold War. Engineering students will have to learn to define and solve problems with greater flexibility. They will need to master the social and intellectual skills required to work in small organizations rather than the megamachines of yesteryear. They will have to understand the environmental contexts of their work.

Responding to today's rapidly changing circumstances, engineering educators need to take stock of their curricula

and their styles of teaching. In workshops and conferences, they must ask themselves: How much of what we offer is truly useful in matching technical knowledge to the human problems and economic challenges of the coming century? Which features of engineering education are stale reflections of crises long past? What do we owe today's students and the society they will eventually serve? ■

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Facing Up to Economic Stagnation

Just beneath the daily flow of negative economic news lies the profoundly disturbing possibility that the U.S. economy is entering a period of persistent, long-term stagnation.

The idea of such stagnation—indeed, the belief in its inevitability—was once commonplace. Such theories enjoyed great influence during the 1930s—especially during the 1937-8 recession within the Great Depression, when the first burst of New Deal programs didn't seem to be working. Many eminent scholars concluded that the normal state of the U.S. economy was neither a hopeful trend of steady growth nor a regular pattern of up-down business cycles (apart from occasional collapses like the Depression). Some detected very long "Kondratieff waves" of extended depression; others held that the normal economic pattern was similar to our current decaying trajectory—what might simply be termed "the doldrums."

For example, Harvard's leading liberal economist, Alvin Hansen, and its foremost conservative economist, Joseph Schumpeter, as well as Marxists like Joseph Steindl all suggested that persistent stagnation was endemic to capitalism because of chronic weak consumption, recurring failure of investment, or both. Several economists targeted "administered pricing"—above-normal profit margins—as a fatal mechanism that drained consumer spending, thereby depleting the purchasing power needed to stimulate new investment.

If these economists were right that the normal state of the economy is recurrently stagnant, what must be explained, of course, is not economic difficulty but temporary periods of prosperity. A good deal of research at the time indicated that previous economic booms were caused by unusual technological developments (such as the railroad during the nineteenth century), population growth, territorial expansion, and the large-scale construction accompanying urbanization. Because it marked the closing of important investment opportunities, many economists judged the end of the



*There may be only so much that
"can-do" people can do.*

U.S. frontier in the late 1890s a major turning point.

Some observers pointed out that a norm of economic difficulty held sway during the first quarter of the twentieth century until "special factors"—war-related exports, together with U.S. military spending during World War I—jolted the system out of recession and near depression between 1910 and 1914. Then another world war intervened during the second quarter of the century to pull the United States out of the Depression. War-related prosperity continued when wartime savings fueled consumer spending in the 1945-49 period, and the Marshall Plan and other investments to rebuild devastated Europe accelerated U.S. export production.

Temporary, war-related factors were again at work during the "postwar boom" of the third quarter of the century. World War II was followed by the Korean War, the Cold War, and the Vietnam War. Military spending—which had fallen to 4 percent of the gross national product in the early postwar

years—shot up to nearly 14 percent during Korea, and averaged roughly 10 percent during the 1950s and only slightly less during the 1960s.

Many of these military-related factors faded as the United States entered the final, post-Vietnam quarter of this century. Military spending declined to an average of 6 percent of the gross national product during the 1970s and 1980s. Another temporary advantage also disappeared: the United States, which had stood almost alone in world markets after World War II destroyed its major competitors, now returned to "normalcy" and again found itself challenged in global trade wars.

Although demographic and other changes have been at work, average unemployment levels have grown as military influences on the economy have declined—from 4.5 percent in the 1950s to 4.8 percent in the 1960s, to 6.2 percent in the 1970s, and to 7.8 percent in the 1980s. Economic growth has also collapsed during this period—from the 4 percent in the first two postwar

decades to roughly 2.6 percent more recently.

Our troubles in this respect may be just beginning: the Pentagon projects that military spending will decline to under 4 percent of gross national product by 1996. Given the plummeting Soviet threat, this figure could well fall further. Several experts have also noted a substantial fall-off in overall investment—and hence economic stimulus—because newer technologies absorb less capital than the heavy industries of earlier eras.

Political Stalemate

With many of the “special” twentieth-century sources of economic stimulus a matter of history, have we at last entered the inevitable stagnation predicted by the theorists of the 1930s? The Reagan administration was able to deal with renewed economic problems by temporarily raising military spending, devaluing the dollar to stimulate exports, and cutting taxes to produce economy-boosting deficits. But all these major cards have been played.

To jump-start the engine, liberal economists today urge public spending; conservatives tax cuts. Given the massive deficit, however, neither is feasible on a scale large enough to significantly affect our huge \$5.6 trillion economy. The remaining policy options of low interest rates and dollar devaluation are similarly constrained—the former because it is difficult to increase investment when business already has excess capacity, the latter because international opposition and fear of inflation set firm limits on this policy tool. Moreover, whatever stimulation does occur when such options apply these days often produces more imports than domestic jobs. Even the industrial policies advocated by some economists can have only modest effect, since trade accounts for only about 10 percent of the U.S. economy compared with 25–35 percent in many parts of the West, and manufacturing constitutes just part of that share.

Other Western nations may be experi-

encing similar stagnation tendencies. But reaching consensus on significant policy changes is much more difficult in the United States. Liberals and moderates have enough power to stalemate any full-scale return to a “free-market” system. And conservatives are in a position to veto the kind of economic planning practiced by many European countries and Japan. A measure of the fundamental nature of the U.S. stalemate is the government’s share of GNP, which hovers around 35 percent, compared with 40–50 percent in many European nations and nearly 60 percent in some Scandinavian countries.

The hobbled U.S. political-economic pattern reflects profound differences in historical development from much of the West, including this nation’s continental scale, racial and ethnic divisions, and absence of a feudal past. The “island-nation” history that has produced the odd Japanese political and policy mix is another world altogether.

All this is not to say that the U.S. economy is likely to collapse. Quite the contrary: the future will undoubtedly bring modest up-down ripples. However, a long-term projection of a plateau, or slow decay, is radically different from the traditional expectation that smaller cycles will converge around a steadily rising trend.

Americans are “can-do” people. We do not find it easy to contemplate the possibility that we may be up against profound difficulties that are not likely to be solved by any obvious mix of near-term policies. Nonetheless, such a forecast is as reasonable as any we may now hear. We must face the fact that we may be in for a sustained period of stagnation that could bring substantial social turmoil—a “time of troubles” that over the longer haul could set the stage for more far-reaching changes in our economic and political system. ■

GAR ALPEROVITZ is president of the National Center for Economic Alternatives and a fellow of the Institute for Policy Studies in Washington, D.C. He is the author, with Jeff Faux, of Rebuilding America (Pantheon, 1985).

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Reviews

BOOKS

WHAT NUCLEAR PLOT?

The Samson Option: Israel's Nuclear Arsenal and American Foreign Policy

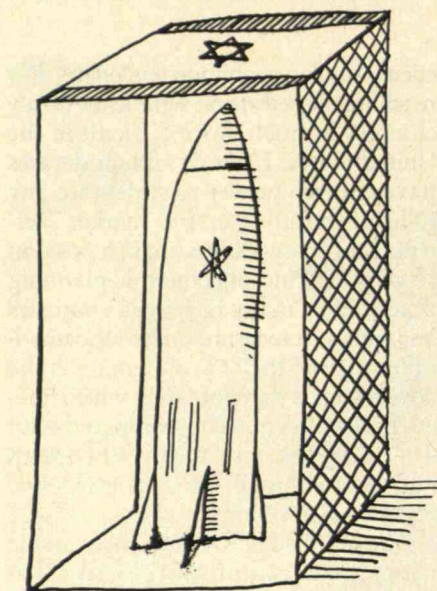
by Seymour M. Hersh
Random House, \$23

BY GERALD M. STEINBERG

OF all nations, Israel may have the best case—perhaps even the only rational one—for possessing nuclear weapons. With responsibility for a microscopically small country facing much larger Arab and Islamic armies capable of annihilating the Jewish state, Israeli leaders have seen nuclear weapons as the ultimate guarantor of survival. In the 1950s, with memories of the murder of one-third of the Jewish people still strong, Israel obtained French assistance in constructing a nuclear reactor at Dimona. Since the mid-1960s, when the plant came on line, the plutonium produced there has been Israel's "weapon of last resort."

Yet for this entire period, no Israeli official has ever acknowledged the possession of a nuclear deterrent. Even at the height of the Gulf War, when Iraqi Scud missiles were falling on Tel Aviv and Saddam Hussein threatened to use chemical weapons to "incinerate half of Israel," it was U.S. Defense Secretary Richard Cheney who warned Saddam that Israel was capable of responding with a nuclear strike. Israeli leaders never explicitly made any such threat.

The official Israeli silence on this issue is primarily the result of sensitivity to U.S. policy. In the late 1960s, shortly after the Dimona reactor reportedly began to produce plutonium, the U.S. government was leading the drive to gain international compliance with the Nuclear Non-Proliferation Treaty (NPT). U.S. presidents beginning with Kennedy have placed emphasis on preventing the spread of nuclear weapons. At the same time, Washington was (and



continues to be) Israel's only supporter and source of military and financial aid. An Israeli declaration of a nuclear capability would undermine the U.S. nonproliferation effort. Although the Israelis had little faith in the NPT, and recognized the inadequacy of the safeguard system for countries like Iraq, they sought to avoid a fruitless confrontation on the issue with the United States.

This policy of silence—neither acknowledging nor denying the existence of a "bomb in the basement," has left the field open to fiction, fantasy, and wild hypotheses regarding Israel's capability and objectives. But ironically, although most authors of "investigative" reports on this topic tend to be critical of Israel's policy, they also increase the visibility, and thus the credibility, of the Israeli nuclear deterrent.

The Samson Option, Seymour Hersh's would-be exposé, follows Tom Clancy's formula for mixing technical detail with plausible historical narrative. Most of the technical information and assertions about Israel's reprocessing plant and development of advanced weapons have been published before, but the claim that many of the country's nuclear weapons were aimed at the Soviet Union is new. According to Hersh, this measure was designed to deter Moscow from providing direct military forces in the event of a future multifront Arab attack like the one that

occurred in 1973. Hersh's rationale and evidence for this claim are based on a handful of unreliable sources and are inconsistent with Israeli security and interests, but those inclined to believe anything they read about Israel will probably accept them at face value.

The book's central theme is the assertion that successive U.S. governments turned a blind eye toward, and even encouraged, Israel's development of its nuclear option. From the beginning, U-2 overflights and U.S. officials who took frequent "picnics" in the desert near Dimona allegedly provided the Eisenhower administration with details about the Israeli effort. Nevertheless, according to the accounts of two former CIA photo analysts, the intelligence concerning Dimona was "rushed over," and no one ever ordered detailed photos.

According to Hersh, this pattern was repeated for 30 years. Under Kennedy, the emphasis on nonproliferation policies increased, Washington directly confronted the Israelis on Dimona, and a series of pro forma inspections took place. However, writes Hersh, Jewish contributors to Kennedy's political campaigns deterred the White House from engaging in a real showdown. (Hersh also claims that the same wealthy Jews financed the Israeli nuclear program). Similarly, he identifies Lewis Strauss, the Jewish head of the Atomic Energy Commission under Eisenhower, as the source of secret support for the Israeli program. Even though President Carter was far less sympathetic to Israel, and expressed even greater concern than his predecessors about nuclear proliferation, he did nothing to stop the buildup of Israel's nuclear arsenal—which, according to Hersh, now includes neutron bombs and boosted super-weapons (in which fission and fusion reactions are combined to create a much greater explosion). American acquiescence in the Israeli atomic effort has, according to *The Samson Option*, continued without interruption.

Yet the case Hersh presents for such connivance is far from convincing. Most of his allegations are based on interviews with secondary actors, many of whom were either guessing or, one suspects,

simply inventing their stories. Hersh conducted no investigations in Israel, relying instead on the tales of shadowy figures such as "Ari Ben-Menashe," who apparently lives in Australia but convinced Hersh he was once a high official in the Israeli prime minister's office. Ben-Menashe was also the source of allegations that Israel sold arms to Iran, but in that case, the details that could be checked independently proved false. When pressed, he was unable to provide any evidence that he had access to the information he claims to know.

Other important information (or disinformation) that Hersh takes on faith comes from unnamed officials. Given the high level of secrecy surrounding the nuclear program, it is unlikely that any Israeli official would have told Hersh that "the final stage of warhead production takes place at a defense plant north of Haifa." Most of the technical claims in the book cannot be checked, but Hersh's ignorance of Israel is painfully obvious. "Scitex," the name of a well-known Israeli firm, is misspelled, for example, and the large commercial institution Bank Leumi is described as "the Israeli state bank." Such clear errors make it difficult to accept the unprovable allegations on which the case depends.

Hersh bases other claims on the official estimates, "leaks," and off-the-record interviews of CIA and other U.S. government operatives. In 1976, a CIA report that Israel possessed 100 nuclear weapons was leaked to the *New York Times*, apparently to force U.S. action against Israel. This claim, like the others cited in the book, was based not on hard information or inside sources but on estimates of the Dimona reactor's capacity and the likely characteristics of a reprocessing plant. The same is true of allegations that Israel has developed advanced forms of uranium enrichment.

Hersh acknowledges that the CIA mistakenly charged Zalman Shapiro, the owner of NUMEC, a nuclear fuel-processing company in Apollo, Pa., with diverting enriched uranium to Israel (the missing material was eventually found in NUMEC's plumbing and on its floor). But Hersh fails to ask whether other CIA

estimates and conclusions are similarly flawed. Despite the full resources of its entire intelligence system, the United States failed to locate Iraq's Scud missile launchers and turned up little information on the Iraqi nuclear program. Nevertheless, when it comes to Israel, Hersh seems confident that the CIA knows where the country's nuclear weapons are and who they are aimed at.

Most important, Hersh never tells us what U.S. governments from Eisenhower through Bush might have done to end the Israeli nuclear program. Israel developed its nuclear capability in response to the clear and continuing threat to the survival of the Jewish people. U.S. arms supplies, economic aid, and verbal guarantees could never substitute for an independent deterrent. This message was repeated by Israeli leaders, beginning with Prime Minister David Ben-Gurion's responses to Kennedy, and was generally understood in Washington. The NPT system, which imposed inspections and safeguards that are easy to circumvent, is little more than a Band-Aid. (In fact, the system made Iraq eligible for technical assistance in developing nuclear energy facilities, which the country later used for military purposes.) Under these circumstances, the United States could do little to ensure Israel's survival and had no chance of convincing Ben-Gurion and his successors to renounce the nuclear option.

In any case, there is simply no support for the claim that the U.S. government acquiesced in or aided the Israeli program. In fact, historical records clearly show that the United States made many efforts to coerce Israel into opening the Dimona reactor for inspection and signing the NPT, all without success. Even had Washington stopped all aid, it is unlikely that Israel would have given up the weapon of last resort. Instead, Israel's sense of isolation and desperation, and hence its reliance on nuclear weapons, would probably have increased. No U.S. administration is happy with the Israeli nuclear capability, whatever its details, but no one has found an acceptable alternative.

Hersh seems unaware that many

Israelis question the wisdom of the bomb in the basement. Some, like Avner Yaniv, of Haifa University, argue that Israel's conventional capability is enough to deter any likely Arab conventional threat. Others argue that the Israeli nuclear capability has provoked similar Arab efforts, and that if Israel renounces this option, the Middle East might become safer and more stable for all. But the current government does not share these views, and, at least for now, Israel can be expected to reject external efforts to quash the nuclear option. A fundamental change in policy would require an end to the threat to national survival and full Arab acceptance of the legitimacy of the Jewish state. When the specter of annihilation disappears, so will the bomb in the basement. ■

GERALD M. STEINBERG is research director of the Center for Strategic Studies at Bar Ilan University in Ramat Gan, Israel.

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BOOKS

THE DILEMMAS OF MEDICAL TECHNOLOGY

Drawing the Line: Life, Death and Ethical Choices in an American Hospital

by Samuel Gorovitz

Oxford University Press, \$19.95

BY JOHN D. STOECKLE

HOSPITALS were once closed institutions. Housing the sick poor and isolating those infected, they were off limits to outsiders, few of whom might care much what went on. But when scientific treatment emerged early in this century—with diagnostic laboratories and sophisticated machines—hospitals soon made themselves accessible to everyone, partly to justify and finance the costly equipment and procedures. Hospitals sought to promote their new capabilities, which promised accurate diagnosis and proper treatment for all classes, all ailments. Since then, outsiders of every stripe—photographers, journalists, sociologists, anthropologists—have received invitations to hospitals to see, hear, and write.

In the last two decades especially, the hospital has become a magnet for ethicists. To be sure, philosophically reflective physicians have been around since Hippocrates; early in this century, for example, Richard C. Cabot, physician turned professor of social ethics at Harvard, wrote sensitively about truth telling in diagnosis and prognosis. But nowadays, interest in medical ethics has been renewed among outsiders as well as insiders.

Driving the ethics revival are more, bigger, and vastly more complex and expensive medical technologies. To some, the hospital has become nothing less than a giant human garage where repair or replacement of our body parts by a host of specialists keeps people running, if sometimes only just. Moreover, the old isolated dyadic decision making

between doctor and patient is now situated in a morass of institutional, social, legal, business, and political interests, and practitioners and patients alike are looking for guides out.

Samuel Gorovitz, a philosopher at Syracuse University does not claim to be such a guide. Rather, he hopes to assist by asking useful questions. In *Drawing the Line*, his sensitive and informative account of seven weeks he spent as participant-observer at Boston's distinguished Beth Israel Hospital, Gorovitz probes the pressing issue of what is the good and right thing to do in patient care. In the process, he provides a revealing look at what hospitals and physicians, and even patients, have become as we approach the twenty-first century. His audience is the general reader who, someday as a patient, may be better prepared to sort through treatment decisions and who, as a citizen, may be able to participate more wisely in public decisions about the uses of medical technology.

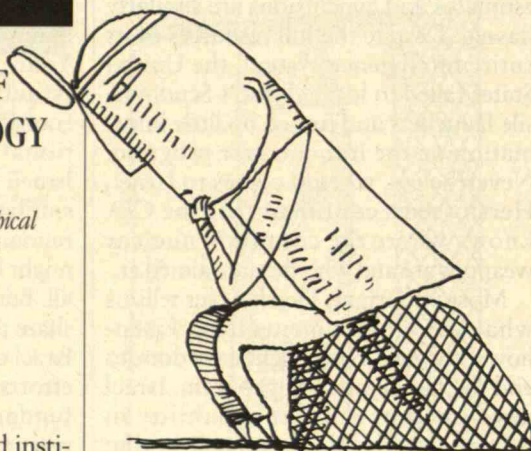
During his residence at Beth Israel, Gorovitz talks with the staff, goes to their conferences and rounds, interviews patients, gives lectures, and, unlike previous outsiders, gets invited to a meeting of the trustees, the center of governance. In the several departments he visits, he constantly encounters people making decisions on what may have become the central question of ethics in patient care: technology use or non-use.

In the hospital's dialysis unit, Gorovitz considers the cost of organ

technologies and the use of transplants. He observes that every new technical development appears to create its own demand. The demand for dialysis is so great that its introduction in the 1960s spawned a federal program that funds treatment for anyone in kidney failure. Yet the newer demand for organ transplants is less easily accommodated. Not only are government and insurance programs now facing cost constraints, but the alternative of using transplants from other species, such as apes, runs up against emotional limits. Despite their feasibility, Gorovitz notes, repairs with parts from animals make humans less human and alter our relationship to other species. Here, as elsewhere, he turns to the theme that treatment decisions do not just involve the individual but inevitably raise questions of social policy, particularly if the costs are enormous and if the treatment might be applied to everyone in need.

Next, in a nearby nursing home and at Beth Israel's Intensive Care Unit, Gorovitz proposes that the same sort of information technology that today is used to make institutional work more efficient could make institutional life more meaningful for the age-impaired. Bedside computer terminals, he writes, could provide games, readings, and maybe interactive connections with friends living elsewhere, giving older people stimulation and control. What Gorovitz does not examine is why this has not already happened. In the unprofitable market of technology for the institutionalized elderly, the ethos of putting patients' welfare first seems to have gone by the wayside.

The next stage of life—death—presents its own ethical issues. Gorovitz writes of attending a cardiac arrest in an older patient with cancer. His scenario is brief: At 4:45 AM he goes to an "arrest on 7" with Arthur, the resident. The patient has been in a coma for several days. Resuscitated, the patient is moved to the ICU with the author tagging along and questioning. Why resuscitate? The staff reply that the patient's children have refused "do not resuscitate" orders.



Gorovitz is concerned about the futility of what he has seen—about the staff's misdirected work and lost sleep. He sounds the hope that physicians and patients will together explore values and preferences prior to death so that drawing the line becomes a mutual decision. In fact, such discussions are more likely now that federal legislation requires hospitals to ask patients if they have drawn up living wills or designated someone to serve as proxy (only 3 percent of patients currently have).

Yet readers should remember that institutionalizing such changes is sometimes inexplicably slow. Just as it took many years to inquire about patients' sex lives (since Freud's introduction of this practice a century ago), physicians find that talking about death, when they are supposed to be saving lives, is a difficult shift to make in the medical interview. As Gorovitz suggests, physicians need patients' help in opening such discussions.

From his meeting with the trustees comes a chapter on "Marketing Health Care" that documents another kind of change—the rise of corporate medical advertising. The glossy junk mail flyers that have begun to turn up in our mailboxes promoting hospital A versus hospital B are designed to draw more paying patients from outside the community and more users of hospital services and products. Gorovitz's reflections that the appeal of these ads is more emotional than rational are to the point, but he ignores a more fundamental problem: the rationale for the market approach to treatment—where care is a "product" and the "customer" is presumed to know what he or she wants to purchase, shops around, and then buys it—is an illusion.

In leaving this stone unturned, Gorovitz fails to take his own good advice that proper care requires joint decision making by patients and professionals. Contemporary ad manipulations notwithstanding, medical care is not a product but a relationship that requires trust between patient and doctor. After all, as Gorovitz previously notes, human beings are not merely

minds attached to bodies, circuits connected to machines that can be fixed or junked according to this economic criterion or that government policy.

Whether physicians can bear this point in mind depends largely on how they are trained. In "Learning Medicine in the House of God," Gorovitz observes that students and residents today seem less driven by the cynicism so confessionally and sensationally portrayed a decade ago in another book about Beth Israel, Samuel Shem's novel *House of God*. Gorovitz nevertheless criticizes medical education and training as narrowly vocational, indifferent to ethical issues and self-reflections about medical acts and decisions.

Yet medical education was already catching up in just these essential areas when Gorovitz was at Beth Israel in 1987. Schools were beginning to incorporate small group tutorials on the doctor-patient relationship and an entire range of ethical issues, as Harvard Medical School does in every stage of its New Pathway curriculum.

Despite his useful insights and lively analysis, Gorovitz overlooks one of the broadest ethical questions of all: the relative merits of hospital care versus disease prevention. The high-tech medicine that has developed in hospitals during the last two decades can certainly benefit patients (as well as boost hospital profits, for that is where the money flows these days). On the other hand, more emphasis on prevention and care outside the hospital, which entails less glamorous interventions, just might reduce the need for massive hospital interventions and improve general health in the bargain. Here the tasks are health education, vigorous treatment to delay the onset of disabilities in people in the early stages of disease, and comprehensive care of the chronically ill and disabled to improve their function and quality of life. Action in this arena benefits individuals in a less dramatic fashion but is at least as important as high-tech medicine. ■

JOHN D. STOECKLE is a professor of medicine at Harvard Medical School and a physician at Massachusetts General Hospital.

BOOKS

UNITING COSMOLOGY AND PARTICLE PHYSICS

The Shadows of Creation: Dark Matter and the Structure of the Universe

by Michael Riordan and David N. Schramm

W.H. Freeman, \$18.95

BY EDMUND BERTSCHINGER

FOR more than 50 years, astronomers have suspected that there is invisible matter hiding in intergalactic space far beyond our solar system, never seen directly by telescopes but inferred to exist through its subtle influence on the orbits of visible stars and galaxies. Closer to home, the ninth planet of our solar system, Pluto, was discovered in 1930 by a search for something perturbing the motion of the planet Neptune, which itself had been discovered 84 years earlier as a result of its effect on Uranus. The physical laws of gravity and motion, discovered three centuries ago by Isaac Newton, were confirmed triumphantly. Astronomers had successfully identified dark matter in the solar system. It wasn't completely dark after all.

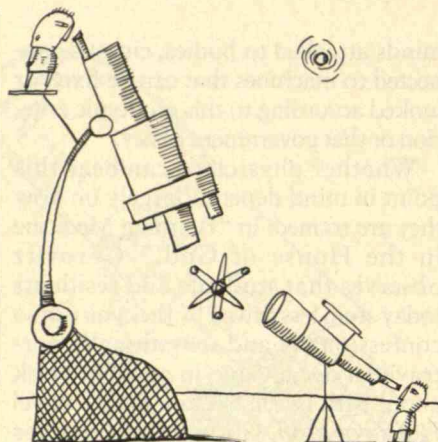
When evidence began to accumulate after 1930 for invisible matter far beyond our solar system, astronomers assumed that they simply had failed to detect distant planets, small stars, or clouds of gas too faint to be seen from earth. During the 1970s and early 1980s, however, evidence accumulated that something was seriously amiss with our prior understanding of the universe. Individual galaxies like our own Milky Way were discovered to be spinning too fast to be held together by the gravity of the visible stars. These violations of the cosmic speed limit could not be attributed to a few errant planets or dim stars. Whole galaxies were found to weigh dozens of times more than the visible stars they contain. More perplexing still, the mysterious mass—dark mat-

ter—was discovered to be most apparent in the distant suburbs of the galaxies, far outside the luminous starry concentrations.

In a different field of research, high-energy particle physics, the 1970s and '80s were a time of rapid progress. One after another, the subatomic secrets of nature gave way to brilliant theories unifying the known particles and forces, tested with atom-smashing accelerators of extraordinary energy and precision. Before long, it seemed that the only major questions remaining concerned theories that could no longer be tested in accelerators on earth. Proving the new "grand unified" theories would require machines larger than our solar system.

Only once in the history of the universe were particles routinely accelerated to the high energies such experiments would demand—roughly 15 billion years ago, during the first tiny fraction of a second after the birth of the universe in the fiery explosion called the "Big Bang." This fact united the study of the smallest objects in the universe, elementary particles, with the study of the largest objects, including the universe itself.

In 1977, in his outstanding book *The First Three Minutes*, particle physicist Steven Weinberg linked modern astrophysics and particle physics, presenting a cosmic history from less than one second after the Big Bang until a billion or so years later, just before galaxies began to form. Today, however, the bonds between particle physics and astrophysics are dramatically deeper, and a new chronicle of that relationship—*The Shadows of Creation*—replaces *The First Three Minutes* as the standard against which other popular accounts of cosmology will be measured. Written by particle physicist Michael Riordan and astrophysicist David N. Schramm, this book details the birth of the new field of particle cosmology. The authors show how modern physicists have pushed the limits of scientific investigation back to the very beginning of time as we know it, and forward to the present day.



Tackling the Big Questions

Led by MIT physics professor Alan Guth, particle physicists have answered questions that astrophysicists didn't think to ask before: Why has the universe continued expanding for so long? Why is the large-scale structure of the universe so smooth? Why is the universe made mostly of matter, rather than a symmetrical balance of matter and antimatter? Might the mysterious dark matter consist of exotic new elementary particles?

Proposing an amendment to the standard Big Bang theory, Guth suggested that in the first fraction of a second after creation, the universe briefly expanded far faster—indeed, exponentially faster—than at any time since. This rapid expansion, or "inflation," made the universe extremely large and smooth, ensuring that it would not recollapse anytime soon. The inflation theory raised, and then provided quantitative answers to, several of the questions mentioned above. The grand unified theories of particle physicists can also explain the prevalence of matter over antimatter, in an abstruse manner first outlined 25 years ago by the late Russian physicist and human-rights activist Andrei Sakharov. As for new elementary particles that might constitute dark matter, theoretical physicists have proposed several candidates with fanciful names such as axions, gluinos, and WIMPs (weakly interacting massive particles). If these particles exist, they may be detectable in laboratory

experiments. Although these ideas have yet to be proven correct, they have tremendously enriched the scope of cosmology.

Today, the basic outlines of Big Bang cosmology are well understood. As Riordan and Schramm demonstrate, the Big Bang theory is—despite occasional news reports to the contrary—still in remarkable accord with observations and experiments. The two authors call on three sturdy lines of evidence.

The first is the fact, discovered by astronomer Edwin Hubble in 1929, that galaxies are rushing apart like shrapnel from a cosmic explosion. Second, the universe is filled with the afterglow of a scorchingly hot past. The glowing radiation would light up our nights if our eyes were sensitive to microwaves instead of visible light. The discovery of this radiation in 1965 led to a Nobel Prize in physics (to Bell Laboratories radio astronomers Arno Penzias and Robert Wilson) and to the elimination of the rival "Steady State" theory, which could explain Hubble's expansion but predicted a cold past. Third, the lightest chemical elements—hydrogen, helium, and lithium—are present in the universe in amounts that closely match those that Schramm and others have predicted would result from the nuclear fusion occurring in the hot, dense early universe. The Big Bang is still the only theory that accounts for all these results.

Even so, as Riordan and Schramm point out, many of the details of Big Bang cosmology are still unknown. For example, how much dark matter is there, and what is it made of? According to Guth's theory, there must be exactly enough dark matter to gradually halt the expansion of the universe through gravitational attraction. Yet the amount of dark matter inferred to exist through its gravitational effects within galaxies falls short of Guth's prediction by a factor of at least 10. Can there be still more dark matter hiding between galaxies? Why is the universe so lumpy—bunched into galaxies and conglomerations of galaxies—today when the uniformity of the microwave background radiation

implies it was extremely smooth 100,000 years after the Big Bang? What made the superlarge, rapidly moving clumps of galaxies and dark matter discovered in the last few years? These questions, at the forefront of modern research, are hotly debated by cosmologists.

Cold Dark Matter

In presenting these controversies, Riordan and Schramm are perhaps too even-handed for their own good. They serve up a bewildering menu of proposed dark matter particles and seeds for galaxy formation. The cosmic string scenario, for example, supposes that enormously long, heavy threads of energy, created (according to some theories) as the universe cooled, stirred up the dark matter, causing it to clump into galaxies. This scenario enjoyed a burst of popularity in the mid-1980s, but it has fallen out of favor with most cosmologists, both for lack of evidence and because of the difficulty of making detailed calculations.

But nature cannot be as confused about galaxy formation as cosmologists are. The authors might have focused more on what is still the most popular explanation for dark matter and structure formation: the cold dark matter theory, which combines Guth's inflation theory with the assumption that dark matter consists of new, slow-moving elementary particles. Although this theory has proven highly successful in accounting for many of the observations the authors describe, they devote more attention to the less successful (and more contrived) theories of cosmic strings.

Nevertheless, there is something to be said for leaving other possibilities open. Cosmologists now realize that understanding the formation of galaxies is harder than they thought even five years ago, and that they have too often overstated their conclusions. Thus they could stand to learn from Riordan and Schramm's measured approach.

EDMUND BERTSCHINGER is an associate professor of physics at MIT. His research interests include dark matter, galaxy formation, and the large-scale structure of the universe.

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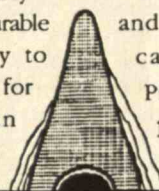
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Perfect Baguette

In France, a great deal of folklore accompanies the question of how to make the best-tasting loaf of french bread. Bakers have long maintained that the quality of a good baguette depends on the strength and elasticity of the dough. Still, some loaves seem to rise better and turn out tastier than others, even under comparable conditions.

Now a team of French and U.S. scientists at the University of California at Berkeley believe they have identified a set of enzymes central to the formation of quality bread dough. According to the researchers, the enzymes, known as the thioredoxin system, can be added to average or poor-quality wheat to yield a superior loaf—a discovery they say could be a boon to all wheat-producing countries. Acknowledging that many bakers in France might be aghast at the idea of using “additives,” French researcher Karoly Kobrehel stresses, “We aren’t adding something to flour that isn’t already there. We are just changing the balance.”

Growing Gulf

Regardless of their opinion of the merit or success of the U.S. involvement in the Persian Gulf War, experts in the energy field agree that U.S. dependence on Gulf oil will grow steadily over the next two decades. Three dozen leading experts from industry, government, and universities presented that view in a report published recently by Stanford University’s Energy Modeling Forum.

The experts disagreed about many particulars, including the pace of world demand for oil and the expected amount of price fluctuation. But they were unanimous in their appraisal that, because of rising oil demand and stable or declining supplies outside the Middle East, the volatile region will increase its market share of the world’s oil supply to almost 50% by the year 2010. By then, they estimate, two of every three barrels of oil consumed by the United States will be imported.

Forest Sludge

Most of New York’s sewage sludge—the end product of wastewater treatment—used to be dumped into the ocean until that practice was banned in 1988. Today, the state’s annual 370,000 tons of sludge are either incinerated, causing air pollution, or trucked to landfills, which are quickly filling up. What to do? A Cornell scientist thinks he has the answer: spread it across the state’s forests.



Analysis by a team led by Douglas Haith, a professor at Cornell’s College of Agriculture and Life Sciences, indicates that the sludge would not adversely affect wildlife—something environmentalists fear because of the material’s residues of heavy metals and other toxic contaminants. Haith says that if the sludge is prudently applied, it will not

contaminate the groundwater. According to his figures, the state’s forests could accommodate almost all of New York’s sludge.

Publicity Helps

It is no surprise that the public gets most of its information about medicine through the media. According to a recent study, though, newspapers’ coverage has a discernable impact on medical research itself. Researchers at the University of California at San Diego found a correlation between the number of citations received by articles published in the *New England Journal of Medicine* and those articles that were written up in the *New York Times*. The researchers chose articles of equally prominent placement in the medical journal and, for further substantiation, also studied articles published during a three-month period in 1979 when the *New York Times* was on strike. The results: medical articles that received coverage in the newspaper received 73 percent more citations in scientific and medical publications than their unpublicized counterparts.

Astro-Newts

A small contingent of Japanese red-bellied newts may have a profound effect on future space exploration. The NASA Space Shuttle’s Microgravity Lab II will observe development of the newts’ gravity-sensing organs in a nongravity setting. Newts are particularly suited for this type of experiment because the female does not release her fertilized eggs until she receives a hormonal signal. This can be delayed, thus ensuring that organ development takes place entirely in space.

Michael Weiderhold, the



University of Texas researcher conducting the experiments, hopes to determine whether babies born in a gravity-free environment have difficulty adjusting to earth’s gravitational pull. The information, he says, could be invaluable in determining the feasibility of lengthy piloted flights or long-term human habitation on orbiting space stations.

Video Government

Industry has used video teleconferencing for years, and last fall Congress decided to take the plunge as well. In fact, it was the House Committee on Science, Space, and Technology that held the first of a series of hearings using the technology. The committee’s deliberations addressed the future of the Department of Energy laboratories with representatives in Washington, D.C., hearing—and seeing—testimony from witnesses at the Los Alamos National Laboratory in New Mexico and California’s Sandia National Laboratory. But the hearings were also designed to demonstrate the prospects for teleconferencing in conducting routine governmental business.

Representative George Brown (D-Calif.), the committee’s chair, believes that the technology can save money and help Congress do its job. Says Brown: “I can envision the day when quick-turn-around hearings and interactions with witnesses testifying from abroad will all be done through video conferencing.”

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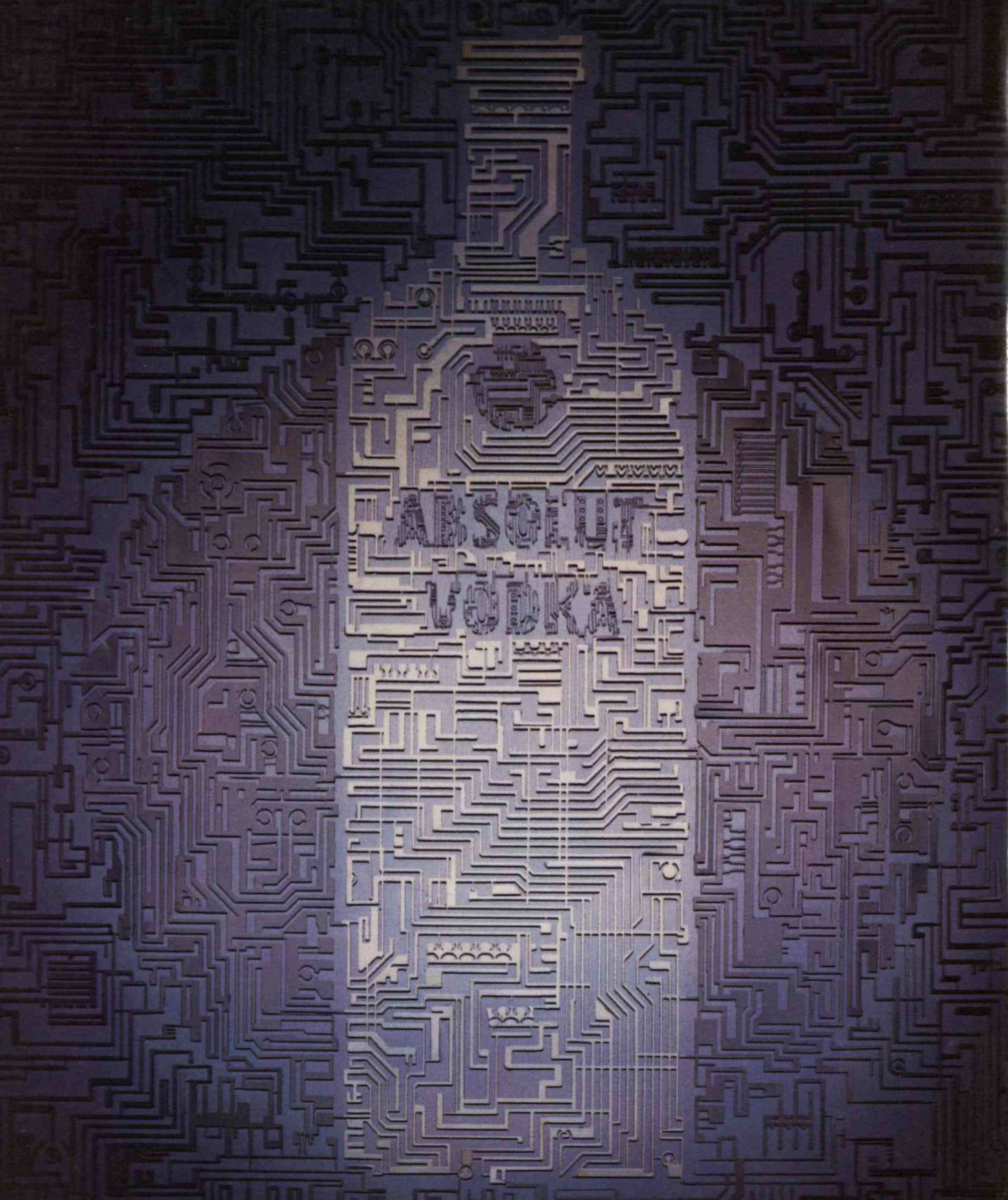
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